Quarterly Review of OPHTHALMOLOGY

Conrad Berens, M.D.
editor-in-chief

INTERNATIONAL RECORD OF OPHTHALMOLOGY

Abstracts on Military and
Aviation Ophthalmology
and Visual Sciences

Conrad Berens, M.D., F.A.C.S.
and L. Benjamin Sheppard, M.D.

VOLUME 7 NO. 3 SEPTEMBER 1951

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INCORPORATING INTERNATIONAL RECORD OF OPHTHALMOLOGY

FOREWORD

The objective of the QUARTERLY REVIEW OF OPHTHALMOLOGY is to bring together in one publication concise but authoritative abstracts of current articles on ophthalmology, according to an all inclusive plan which will include all special, state, and national journals as well as the bulletins of clinics, hospitals, etc., and the transactions of meetings. This will embrace both the domestic and foreign literature.

To assist the reader to locate quickly the articles of current interest all data will be classified and published according to the following systematic plan:

Anatomy, Embryology, Heredity, Development and Nutrition
Optics, Physiology and Psychology of Vision
Physiology, Chemistry and Biochemistry of the Eye
Pathology, Bacteriology and Immunology
Diagnostic Methods of Examination Biomicroscopy and Photography
Ocular Movements and Motor Anomalies, Nystagmus, Reading Disability
Anomalies of Refraction and Accommodation, Contact Lenses
Conjunctiva
Cornea, Sclera and Tenon's Capsule
Anterior Chamber and Pupil
Uveal Tract and Sympathetic Ophthalmitis
Crystalline Lens
Vitreous Humor
Retina
Neuro-Ophthalmology, Optic Nerve, Visual Pathways, Centers and Visual Fields
Eyeballs, Exophthalmos and Enophthalmos
Glaucoma and Hypotony
Lacrimal Apparatus
Eyelids
Orbit
Allergy
Anesthesia
Medical Ophthalmology
Pharmacology, Toxicology and Therapeutics
Comparative Ophthalmology
Tropical Ophthalmology
Hygiene, Prophylaxis, Occupational Ophthalmology and Injuries
Illumination and Illuminating Engineering
Ophthalmic Sociology
Education, History and Institutions
Miscellaneous
Book Reviews
Announcements

In each section there will be published a series of annotated references under the heading, "References to Current Articles." To save the reader's time and also to assist in the compilation of bibliographies these references will invariably refer to articles of an academic nature or those making similar reports to abstracts recently published on the same subject. A cumulative index in the concluding numbers of each volume will provide further aid in locating specific references. Constructive criticism will be appreciated.

A section entitled International Record of Ophthalmology is to be included at the beginning of the journal. The Record Section will consist of advanced clinical and experimental reports.

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1. Swan, K. C.: Tr. Am. Acad. Ophth. & Otolaryng.; March-April 1951 p. 406.
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Incorporating the International Record of Ophthalmology

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CONRAD BERENS, M.D., F.A.C.S., AND BENJAMIN SHEPPARD, M.D.

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VOLUME 7 NO. 3 SEPTEMBER 1951

Incorporating the International Record of Ophthalmology

ABSTRACTS

ophthalmology

OPTICS, PHYSIOLOGY AND PSYCHOLOGY OF VISION

Some Psychological Factors in Flicker and Fusion. GEORGE W. KNOX, Columbus, Ohio. Am. J. Optom. & Arch. Am. Acad. Optom. *28*:221-26, April 1951.

It was noted that, during the training of subjects, in preparation for an investigation of the effect of perceptual shape and simultaneous auditory perception on the visual critical flicker frequency (C.F.F.), the attitude of the subjects showed significant effects on the C.F.F. recordings.

A separate investigation was then made, regarding the effect of the attitude, itself, on the perception of flicker and fusion. Six untrained subjects were selected and divided into three groups of two each. Twenty monocular C.F.F. readings were taken of each subject daily, for 10 successive days.

For the neutral attitude group, instructions were given in the ordinary manner. For the flicker attitude group, it was especially stressed they were doing flicker experiments; they were instructed to say when flicker appeared or disappeared during the changes in flash frequency. The fusion group understood they were doing fusion experiments and reported when fusion appeared or disappeared during changes in flash frequency.

Results showed a rather marked rise of the C.F.F. for the flicker group, a fairly marked fall of the C.F.F. for the fusion group, and a very slight rise of C.F.F. for the neutral group—with and without the artificial pupil.—*Author's abstract.*

Veridical Perception. EUGENE FREEMAN, Chicago, Ill. Am. J. Optom. & Arch. Am. Acad. Optom. *28*:213-20, April 1951.

The primary problem of the paper is the reliability of visual testimony. Cases of conflict between the visual and tactual senses are considered, and a criterion is proposed for distinguishing between false and true perceptions. Nonveridical perceptions, which are fabrications of our perceptual apparatus, are inconsistent with the rest of our experience and are disclosed by their conflict with the testimony of other senses which do not conflict with our experience.

The contributions of Immanuel Kant and John Dewey to the philosophy of perception are briefly considered. Dewey's definitive transactional theory of perception is stated briefly. According to Dewey, perceptions are altered by the past experience

and present assumptions of the knower. Adelbert Ames of the Hanover Institute has devised a number of ingenious and original experiments, which have attracted great interest as challenging and graphic demonstrations of certain basic facts and principles of veridical and nonveridical perception.

The basic empirical phenomena disclosed by the Ames demonstrations are incontrovertible facts. Accordingly, no theory of perception which fails to account for these facts can hope to stand. As Ames and Dewey have pointed out, the Ames demonstrations are consistent with Dewey's transactional theory and constitute its most important empirical confirmation.—*Author's abstract.*

Flicker Fusion Threshold in Normal Persons. NOAH D. FABRICANT AND THADDEUS R. MURROUGHS. Chicago, Ill. Eye, Ear, Nose & Throat Monthly, *30*:146-48, March 1951.

During the past decade there has been a pronounced upsurge of interest in a fundamental visual phenomenon known as the flicker fusion threshold. It refers to the frequency with which successive flashes of light appear to the eye as apparently solid light. The ability of the human eye to perceive successive flashes of light has been related, by various investigators, to such diverse factors as age, general and specific fatigue, glaucoma, detached retina, brain tumors, brain injury, and an aid in evaluating the therapeutic effect of medication.

The purpose of this investigation has been twofold: to ascertain the flicker fusion threshold in a group of young, presumably normal individuals; to determine the effect of distance and illumination on the flicker fusion threshold of these subjects. The instrument employed was a Krasno-Ivy flicker photometer.

A total of 45 presumably normal persons were selected at random from an undergraduate student body. All the testing was done daily, over a one month period. In an attempt to establish reliability of the technic, a test-retest procedure was adopted for all conditions of distance and illumination; each of the 45 subjects was recalled and all the tests were repeated.

In regard to illumination and distance, it was found the flicker fusion rate drops as distance is increased and also as room illumination is decreased. At a selected standard distance of 1.6 meters (5 feet), the range of findings, which represents the means, varies between 2.582 and 2.638 flashes per minute (between 43 and 44 flashes per second). 6 references, 2 tables.—*Author's abstract.*

DIAGNOSTIC METHODS OF EXAMINATION, BIOMICROSCOPY AND PHOTOGRAPHY

The Ophthalmoscope for Examination of Skin Lesions. MORTON B. WALLACH. New York, N. Y. New York State J. Med. *51*:262, Jan. 15, 1951.

The ophthalmoscope can be used as a substitute for the dermatologist's loupe in the examination of skin lesions. With the plus 20 diopter lens in place and the physician's eye at the lens, the ophthalmoscope, held at about 4 cm. from the skin, gives adequate magnification and projects a small cone of light on the area which one wishes to study. Lesser degrees of magnification, as required, are literally at

the examiner's fingertips by choosing any weaker lens in the ophthalmoscope. Somewhat larger areas may be studied by removing the pinhole diaphragm cap from the instrument. Therefore, the skin can be conveniently subjected to careful scrutiny.—*Author's abstract.*

OCULAR MOVEMENTS AND MOTOR ANOMALIES, NYSTAGMUS, READING DISABILITY

The Effect of Base-Out Prisms on Eye-Hand Co-Ordination. NEAL J. BAILEY, Columbus, Ohio. Am. J. Optom. & Arch. Am. Acad. Optom. *28*:87-91, Feb. 1951.

Preliminary qualitative studies on projection by the hand-pointing method in binocular individuals indicated a marked tendency to point too far to the left when using the right hand and right eye and too far to the right when using the left hand and left eye. Since this would complicate the investigation of anomalous correspondence, it was decided to study this phenomenon on a quantitative basis.

Apparatus was set up to prevent the subject from seeing any part of his arms or hands. An optical pointer, adapted with trigger and pistol grip, was used to "shoot" at targets, while the subject wore base-out prisms equally distributed between the two eyes.

Results on 10 normal subjects indicate that eye-hand co-ordination involves no direct connection between either eye and the homolateral hand; nor does the position of the eye in the orbit directly influence the direction in which the hand points. 1 table, 4 figures.—*Author's abstract.*

Clinical Significance of the Abduction Findings. J. DONALD KRATZ, Philadelphia, Pa. Am. J. Optom. & Arch. Am. Acad. Optom. *28*:11-18, Jan. 1951.

The article calls attention to the relative stability of the prism base-in, to break findings with fixation at infinity. In a survey of 27 cases, with a tonic exophoria range from 3 to 10 prism diopters and no history of heterotropia, the abduction finding was found to move an equivalent amount in an outward direction.

The above findings suggest that the abduction break point may be used as an indicator of the tonic phoria position if allowance of 8 to 11 prism diopters is made for the range from the phoria to the break point. This allows a differential diagnosis between an accommodative and a tonic esophoria.—*Author's abstract.*

Method for Objective Investigation of Strabismus. EMANUEL KRIMSKY, Brooklyn, N. Y. J. A. M. A. *145*:539-44, Feb. 24, 1951.

A flashlight and prism are adequate tools for studying the corneal light reflexes. The corneal light reflex, when studied in a controlled manner, is the only dependable landmark or guide for an objective evaluation of normal straight eyes, as well as manifest strabismus.

Accurate observation of the positions of the corneal light reflexes is essential in a study not only of ocular deviation but also of induced or spontaneous image responses.

With the prism reflex test, based on the property of a prism to reflect a beam of light toward its apex, the amount of strabismus can be measured objectively.

The corneal light reflex can be used to study the state of binocular balance, binocular position, and binocular function.

Diagnosis of Abnormal Retinal Correspondence. A. SCHLOSSMAN. New York, N. Y. Eye, Ear, Nose & Throat Monthly. *30*:25-28. Jan. 1951.

Binocular vision is the result of interplay between the motor and sensory components of the visual apparatus. The state of retinal correspondence indicates the extent of the sensory imbalance in a patient with strabismus. Corresponding areas or elements of the two retinas receive images of the same object and have the same local sign of direction. Abnormal correspondence may develop in strabismus where a certain degree of binocular cooperation exists in the presence of suppression of the deviating eye. Since the strabismus has altered the motor relationships between the two eyes, the sensory balance must adapt itself to new conditions, namely, esotropia or exotropia. Consequently, the fovea of one eye and an extrafoveal element of the other eye will develop a common visual direction, thus giving rise to anomalous retinal correspondence. Abnormal retinal correspondence is a binocular function. In the absence of eccentric fixation, if the fixing eye is covered, the fovea of the deviating eye takes over fixation and the eye appears straight.

There are two types of tests for measuring abnormal retinal correspondence. The maculo-macular test, par excellence, is the afterimage test. The patient fixates the straight filament lamp with the fovea of each eye and compares, by means of his mental images, the macula of one eye with that of the other eye. The major amblyoscope and double image tests are described as examples of maculo-paramacular tests. In these tests the ophthalmologist measures the subjective and objective angles of squint and compares the two. The subjective angle is measured with both eyes open so that a patient with anomalous retinal correspondence uses the fovea of one eye and disparate elements of the other eye at the same time.—*Author's abstract.*

ANOMALIES OF REFRACTION AND ACCOMMODATION, CONTACT LENSES

Accommodative-Convergence in Presbyopia. MEREDITH W. MORGAN, JR., Berkeley, Calif. Am. J. Optom. & Arch. Am. Acad. Optom. *28*: 3-10. Jan. 1951.

In this study the phoria, through the prescribed "add" for a 40 cm. fixation distance, was determined for 400 presbyopic subjects: 9 Δ exophoria ± 5.5 Δ was the mean value found.

When the subject looked through the add +0.50 D and through the add −0.50 D, the phoria was able to be determined. The difference in these two findings represents the change in convergence for a unit change in accommodation—the A.C.A. ratio. Since the target distance remained constant, proximity effects should remain the same for both findings. The resulting subtraction of one finding from the other should eliminate this factor 3.8 Δ / 1.00 ± 2.6 Δ / 1.00 D was the mean found.

This compares favorably with the A.C.A. determinations by a similar method on

nonpresbyopic subjects of Morgan (1944) who found 4△/1.00 D and 3.1△/1.00 D found by Emmes (1949). This seems to indicate that the A.C.A. ratio does not change with age, and the physiologic effort of accommodation also remains constant. 15 references, 3 tables.—*Author's abstract.*

A Report on Ten Cases Fitted with the Feinbloom Self-Centering Corneal Contact Lens. IRVING VICS, Albany, N. Y. Am. J. Optom. & Arch. Am. Acad. Optom. *28*: 147-53, March 1951.

The author states that this new lens, introduced by Feinbloom in 1949, represents a definite advancement in contact lens fitting. It has increased wearing time, given the patient greater comfort, is invisible, and has reduced fitting time to as little as one visit in the simpler cases. Fitting is more accurate because the correct lens is completely self centering from the moment of its insertion.

Of the 10 case reports submitted, 3 patients were female and 7 were males. The number of office visits required for fitting was one to three for 9 cases, and eight visits for 1 case. The patients reported after having worn their contact lenses from 2 to 11 months. One patient could wear the lenses for 2 hours, 1 patient for 4 hours, 1 for 6 hours, and 7 could wear them from 8 to 14 hours. The Alpha Feinbloom lens was used in 1 case, the B Feinbloom lens in 7 cases, and the C Feinbloom lens in 2 cases. These 10 cases, taken as a group, presented a much more different aspect of contact lens fitting than previously experienced by the author, who had fitted many types of contact lenses. With these new lenses, there were fewer deprecating remarks from patients, and the lenses seemed to come up to the patients' expectations. All patients have continued to use their lenses, which is considered a significant point.

Compensatory Cyclo-Torsion and Visual Acuity, WILLIAM G. WALTON, JR., Philadelphia, Pa. Am. J. Optom. & Arch. Am. Acad. Optom. *28*:84-86, Feb. 1951.

Since a head tilt of 30 degrees results in a compensatory cyclo-torsion of 10 degrees, a person wearing a cylindrical correction will, in the tilted head position, no longer have the meridian of least refractive power of the eye coincident with the axis meridian of the ophthalmic lens.

This investigation is to determine the effect on visual acuity by tilting the head 30 degrees toward the shoulder and turning the cylindrical axis 10 degrees from its proper position.

Using an Ives visual acuity meter and a special framework to determine the proper head position, the visual acuity of 25 subjects whose cylindrical correction was at least 1.00 diopters was determined.

Test 1: Head is in the normal position.

Test 2: Head is tilted 30 degrees toward the shoulder. The head was tilted toward both the right and left shoulders and the findings averaged.

Test 3: Head in the normal position and the cylindrical axis turned 10 degrees. The cylinder was turned 10 degrees in one direction and then 10 degrees in the opposite direction, the findings were then averaged.

In each case a reduction in visual acuity is found when the head is tilted toward the shoulder. A still greater reduction in visual acuity is found when the cylinder is turned. It seems apparent that some compensatory action in the interpretation of what is seen occurs when the head is tilted while wearing a cylindrical correction. Just how this compensation is brought about is not known at the present time.—*Author's abstract.*

CONJUNCTIVA

The Bacteriology of Eye Infections in the Mid-West, U. S. A. R. I. PRITIKIN, AND M. L. DUCHON, Rockford, Ill. Mil. Surgeon *108*:309-13, April 1951.

A study of infections of the outer eye and lids was conducted in a highly industrialized midwestern city with a large surrounding agricultural area. Cultures were made directly from the eyes, and smears were made from the secretions. Seventy infections of the outer eye and adnexae were so studied, and it was found that 50, or 71.4 per cent, were caused by *Staphylococcus aureus* organisms. Ten, or 14.2 per cent, were caused by the *beta hemolytic streptococcus*. Nine, or 12.8 per cent, were due to *pneumococcic* infection. One was an extremely rare infection caused by *fuso-spirochetosis*. The appearance of the eyes or of the secretions was not characteristic in any group. No cases of *moraxella, Koch-Weeks bacillus*, or *fungus* infection were seen during the time of the study.

The very effective modern treatment with aureomycin and furacin is described, and the use of Burow's solution for soaking inflamed lids is presented. 2 figures, 1 table.—*Author's abstract.*

Anti-Trachoma Campaign in Gozo. V. TABONE, Gozo. Brit. M. J. *2*:738-40, April 7, 1951.

Since 1948, I have been conducting an intensive anti-trachoma campaign on the island of Gozo (near Malta), which has a population of about 28,000 inhabitants. Out of a total of 4,058 school children, 721 were found to be suffering from trachoma, and 926 cases were found among their contacts. District medical officers have found 612 cases among 12,698 persons of the general population examined so far. The above figures show clearly that trachoma is much more prevalent among school children than among persons of other age groups and occupations. Diagnosis was based on the finding of trachoma follicles on examination by a loupe in a good light.

Treatment consisted in giving sodium sulphacetamide tablets orally for one to three periods of 10 days each, in the use of 30 per cent sulphacetamide solution dropwise three or more times a day, and in the application of 6 per cent sulphacetamide ointment at night. Local use of sulphacetamide was continued until all follicles had disappeared and the conjunctiva had become smooth and shining. Results were very gratifying. The duration of treatment depended on the stage of the disease and on the regularity and assiduity of treatment. After a period of 21 months, only 6 school children were still under treatment. 2 tables.—*Author's abstract.*

CRYSTALLINE LENS

Cataract Extraction with the Erisiphake. HAROLD B. ALEXANDER, Pasadena, Calif. California Med. *74*:38-40, Jan. 1951.

The erisiphake is not a new ophthalmic instrument, but its modern application to cataract surgery has greatly facilitated the successful delivery of all types of cataracts in the adult. It has long been recognized that the intracapsular method of lens extraction is generally superior to the extracapsular procedure; however, several inherent defects of the forceps technic of cataract extraction have impaired the efficiency of that operation. The erisiphake is essentially a vacuum cup, or pneumatic forceps, which provides several advantages over the ordinary lens forceps. It permits a firmer control of the lens during the delivery and makes possible a higher proportion of intracapsular extractions with a minimal use of external pressure and with less danger of rupture of the lens capsule or loss of vitreous.

That the forceps method of lens extraction has been far from perfect is evident from published reports. These reports show that the forceps operation succeeds in little more than 70 to 75 per cent of cases, with rupture of the lens capsule in approximately 20 to 30 per cent of cases, loss of vitreous in at least 5 per cent, and inability to grasp the capsule with the forceps in 10 per cent of cases. In contrast to this, the percentage of successful intracapsular lens extractions with the erisiphake has been increased to 90 per cent, or more, with much fewer complications.

When the suction cup is applied accurately to the lens capsule, a firm but delicate grasp of the lens is achieved as soon as the vacuum pump is turned on. Very little pressure need be applied to the vitreous body, for the zonular lamellae usually rupture readily; however, some counterpressure should be maintained to guide the lens through the corneal section. The motor-driven erisiphake provides a constant suction, which the surgeon is able to control immediately.

The surgeon who uses the erisiphake has the gratifying assurance that the vast majority of cataracts in the adult can be extracted intracapsularly without loss of vitreous and with excellent visual results. 10 references.—*Author's abstract.*

It is difficult to recognize the statistics given for forceps extraction for comparison.—D. B. K.

Problems of Cataract Surgery. G. DE OCAMPO, Manila. P. I. Philippine J. Surg. *6*:3-11, Jan.-Feb. 1951.

Some basic and technical problems observed in other operators, or encountered personally after 500 cataract extractions, are discussed.

There is the problem of knowing the patient, his purpose in submitting to the operation, his preconceived misconception about the operation keeping his fear and anxieties from other patients, his confidence in himself to behave, and his confidence in the surgeon of his choice.

Whether to refuse or postpone an operation should depend on the balance between the expected gain in vision both by the patient and surgeon against the risk of operation, with the "batting average" and confidence of the surgeon as a background.

The surgical objective of knowing the characteristics of the cataract, is to plan the best manner of delivering it. It is concerned with the tenseness, the thickness, and the strength of the capsule, as well as the condition of the zonule. The strength of the zonule cannot usually be appraised by the slit-lamp unless ruptures are visible. In general, however, the younger the patient the stronger is the zonule, while the more complicated and the more hypermature the cataract the weaker it is. Know the size of the cataract beforehand, particularly its nucleus as well as its consistency and moldability.

Attention to details in all the phases of cataract surgery should be a habit. All available instruments should be ready.

The problems in sedation basal general analgesia and anesthesia are: individualization, dosage, timing, and hypersensivity. Akinesia is the most important preoperative procedure to prevent complications of cataract surgery.

No method of extraction is the best for all kinds of cataract by different operators. Hence, the aim should be to develop a system and not a single method and to determine and apply the safest, the most effective, and the best available maneuver under the circumstances of a particular extraction.

The rectus bridle suture is more effective when introduced about 2mm. from the scleral attachment. The conjunctival flap reinforces the sealing and healing of the corneal incision and aids in the manipulation of the cornea. Preplaced, appositional, corneoscleral sutures have more advantages than other forms of suturing. To be truly effective there must be at least two in number, and it must pierce at least one-third of the corneal and scleral thickness; to be appositional it must be on the same level at both edges, exactly meridional, with the center of the cornea as the target.

In making the corneal incision with the Graefe's knife, plan to hit the corneal slot at the counterpuncture, and make it in one stroke.

Total iridectomy is indicated in a rigid or adherent pupil, a proportionately hard or big cataract, and where the iris may not be made to retain its normal position, as in vitreous prolapse, or a patient will not behave, has cough, vomiting, sneezing, etc. To free the lens from the zonule, with the least force and the least disturbance of the different ocular structures, is the main problem of intracapsular extraction. Whether by the vitreous wedge or by direct or indirect pressure on the stretched zonular fibers, the principle of breaking the zonule part by part, requiring less force, is the principle in tumbling and rocking movements.

The second great force in lens delivery is the traction on the lens. The problems are on which type of cataract to apply it and how, where, when, and how much of it to apply. How to apply it has given rise to many types of capsule forceps, different makes of erisiphakes and to loupe or spoon deliveries or even to diathermy coagulation of the lens. Where to apply the forceps, would depend on one's method. After grasping the capsule by forceps or suction, traction can be started even before any zonular fiber gives way. In general, however, the greater the number of zonular fibers broken, the more is the indication for traction, limited, of course, by one's estimate of the capsule's strength. How much of the traction to apply must be midway between the force to break the capsule and that force which helps in delivery at its various

phases, as well as the security of the grasp.

The third force in cataract surgery is direct pressure or push on the lens. The problem again is how, where, when, and how much to apply.

It is the interplay and right combination of these three forces for lens delivery that make cataract extraction a really fine art. There is a need for generalship because where one kind of force is effective for an objective another variety or greater strength must be applied. When to withdraw a force or to retreat and when to apply it with increasing pressure needs good judgment. Likewise the limit of the strength of the force applied must be learned by intuition and aided by sight.

The problem of vitreous prolapse depends on the removal of all possible extra- and intra-ocular pressure and knowing beforehand the intactness and conditions of the hyaloid or the fluidity of the vitreous.—*Author's abstract.*

Advances in Cataract Surgery. ELBYRNE G. GILL, Roanoke, Va. Eye, Ear, Nose & Throat Monthly *30*:191-96, April 1951.

The technic, which we use, is based on the observation of 400 cases. We use local anesthesia; Van Lint akinesia; a keratome incision, widened to 180 degrees with scissors; a combination of two corneoscleral sutures; a 180 degree conjunctival flap, closed by additional sutures. We hold the lids open and the eye down with silk sutures and deliver the lens by the head-on method. The patient is permitted out of bed 24 hours postoperatively. With this technic we have achieved a visual acuity of 20/25 or better in 90 per cent of our patients; we have reduced hemorrhage to 3 per cent, and vitreous loss to 2 per cent. We emphasize that this operation is not designed for speed, but rather for safety and accuracy. 16 references, 6 figures.—*Author's abstract.*

RETINA

The Treatment of Detached Retinae. H. H. MACRAE, Canada. Canad. M. A. J. *64*:335-37, April 1951.

The appearance of spots before the eyes, or flashes of light, and the finding of a hemorrhage in the vitreous may indicate that a detachment of the retina is present. If a detachment is seen, a hole must be found. Holes are most commonly seen in the upper temporal quadrant; disinsertions are most common in the lower temporal quadrant.

The patient should be put to bed, his head immobilized, atropine instilled in the diseased eye, and his eyes bandaged and covered with a black mask. A tendency of the retina to fall back suggests a good prognosis. The hole is localized with the aid of a Schweigger perimeter and Stine's tables.

When operating keep the cornea clear and the pupil dilated. Place one diathermy puncture at the calculated site of the hole. Then, after checking the position of the original puncture in relation to the hole, surround the hole with two rings of diathermy punctures.

After operation, the patient remains in bed for two weeks and is then gradually allowed up.

Primary Pigmentary Degeneration of the Retina and Intercurrent Disseminated Choroiditis. A. H. KEENEY, Louisville, Ky. South. M. J. *44*:38-42, Jan. 1951.

A case of classical retinitis pigmentosa is reported with a complicating acute, unilateral, idiopathic, disseminated choroiditis. For over six weeks this intercurrent infection responded to intravenous typhoid vaccine, local atropine, and systemic penicillin. The following should be differentiated from primary pigmentary degeneration of the retina (PPDR): secondary PPDR (healed diffuse luetic choroiditis and luetic neuroretinitis, diffuse superficial choroiditis in the pigmented stage, and rubella retinitis); ophthalmia hepatica, conditions with similar fundus pictures (Batten's disease, toxic reactions to Pregl's solution, and old dislocated lenses). Though choroiditis is a unique complication, the following associated conditions have been reported: polar cataracts, glaucoma, vitreous and retinal detachments, macular holes, dystrophies and cysts, iritis, hypopion ulcer, quinine amblyopia, and Laurence-Moon-Biedle syndrome.

No current treatment for PPDR is effective. The physician should determine the genetic pattern involved and render eugenic advice to PPDR patients.

Genetics of the three common modes of inheritance are reviewed. In simple dominant form (affecting about 50 per cent of the offspring: all affected persons have affected parents; normal offspring have only normal children), there should be no progeny, unless it is considered right to produce children who will become blind. In the sex-linked recessive form, one-half of the sisters and all the daughters of an affected male will pass PPDR to one half of their sons; unaffected daughters and sisters must be advised of their responsibility. In simple recessive form, PPDR appears only if both parents, who usually appear normal, carry the gene. In such families marriage within the pedigree, or into families carrying the defect, should be prohibited or sterile. 15 references. 1 figure.—*Author's abstract.*

Central Serous Retinosis and its Relation to Other Acquired Impairments of Central Vision. ARTHUR H. KEENEY, Louisville, Ky. J. Kentucky State M. A. *49*:148-52, April 1951.

Central serous retinosis (central serous choroiditis, retinitis centralis annularis, and central angiospastic retinopathy) is usually a unilateral macular disease of males between the ages of 30 and 45; it is marked by moderate impairment of central vision. The eye is painless, free of inflammatory signs, and clinically shows localized retinal edema in the macular area, with a few punctuate, yellowish deposits. A relative central scotoma and transient hyperopia are commonly demonstrated. The course tends toward gradual improvement in several weeks, but relapses occur. Etiology is obscure but has been associated with hyperacute allergic states. Skin capillary function studies give no reliable evidence of capillarospasm. A typical case is reported which improved with vasodilators. Current therapy is aimed at vasodilatation, antiallergic management and general measures (elimination of toxic factors and focal infections, relief from anxiety, correction of metabolic disturbances, and avoidance of vasospastic agents). Intravenous procaine has appeared to offer much promise in a few subsequent cases.

The second half of this paper is a clinically differential study of conditions which may be confused with this disease because they are painless, without other eye manifestations, and are brought to the patient's attention by impairment of central vision. These include, central choroiditis, acute axial retrobulbar neuritis, senile macular degeneration, juvenile disciform degeneration of the macula, idiopathic juvenile degeneration of the macula, Berlin's edema, cystic degeneration of the macula, Leber's disease, actinic retinitis, certain toxic amblyopias, neoplastic detachments of the macula, posterior detachment of the vitreous, central relapsing retinitis, occlusion of a cilioretinal artery, and heredofamilial degenerations of the macula. 8 references.—*Author's abstract.*

NEURO-OPHTHALMOLOGY, OPTIC NERVE, VISUAL PATHWAYS, CENTERS AND VISUAL FIELDS

A Case of Bilateral Papilledema. R. R. RAMSAY, Canada. Tr. Can. Ophth. Soc. 39-43, 1951.

A 6 year old white boy showed bilateral papilledema and an increased cerebrospinal fluid pressure. At the age of 7 years, he was found to have proptosis of the left eye and optic atrophy. At the age of 11 years, the optic atrophy was bilateral, and the optic foramina were enlarged. At the age of 13 years, a mass could be felt behind the left eyeball; it was removed and found to be a glioma.

The patient later developed severe symptoms of increased intracranial pressure; a bilateral Thorkildsen's procedure was done to relieve an internal hydrocephalus. Roentgenograms showed a large midline tumor in the region of the chiasma, destruction of the floor of the sella turcica, and bilateral enlargement of the optic foramina. 13 references. 2 figures.

The Relationship between the Size of the Blind Spot and the Presence of General Infection. MONROE J. HIRSCH, AND MAX SCHAPERO, Los Angeles, Calif. Am. J. Optom. *28*:233-41, May 1951.

The recent claim of Davidsen that blind-spot size was reduced in infections of the head and neck region was subjected to controlled experiment. From a group of 140 students, who answered a questionnaire, the 24 most likely to have an infection, and the 25 least likely to have an infection, were selected. The blind spot was slightly (non-significant statistically) larger for the group with suspected infection. The white blood-cell count was determined for all of the subjects and was found to be related both to suspected infection and to blind-spot size. The group, who on the basis of the questionnaire suspected they had an infection, had a white count (average) of 1,100 cells more than the control group. The correlation (+0.28 P=0.05) between blind-spot size and white blood-cell count was in the direction of a higher white count being associated with a larger blind spot. No basis for the claims of Davidsen could be found.

An interesting observation, not having to do with the problem *per se*, was encountered in the observation that persons without tonsils had on the average one more

cold per year than those who retained their tonsils. This relationship was demonstrated to have statistical significance, and no attempt is made to explain it. 3 references. 2 figures. 3 tables.—*Author's abstract.*

Suprasellar Meningiomas. Report of an Atypical Case. HAROLD H. JOY, Syracuse, N. Y. Am. Ophthal. Soc. Meet. June 7, 1951.

Meningiomas represent one of the more frequent and hopeful types of brain tumor. If discovered early they can ordinarily be removed without fear of recurrence. And even if extirpation of the tumor is not complete, subsequent regrowth usually is quite slow.

Suprasellar meningiomas are of particular concern to the ophthalmologist because the first signs, and often until very late, the only signs, are in his domain. As a rule, subjective symptoms are not constant, helpful neurologic findings are rarely present, and plain skull films show little or no bone changes. In typical cases, pressure on the chiasm causes early bitemporal field defects and the resultant picture of primary optic atrophy. However, if the prechiasmal portions of the visual pathways are primarily involved, the train of symptoms is quite different because the function of one eye may be impaired for a considerable time before the other eye is affected. And since the rapid development of central scotomas is characteristic of these cases, the condition may simulate retrobulbar neuritis.

Such was true in the case presented, in which the outstanding features were the sudden onset of an apparent retrobulbar inflammation in the left eye, followed, over two years later, by temporal and central field defects in the right eye. No other significant signs or symptoms even were present, and plain skull films failed to disclose any significant abnormalities. Persistence of the visual loss in the left eye indicated that the tentative diagnosis of retrobulbar neuritis was not correct. Unfortunately, circumstances caused delay of angiographic studies until the right eye was seriously affected. By then it seemed probable that we were dealing with a slow growing tumor in the region of the chiasm. Angiography suggested the presence of a meningioma, which at operation proved to be suprasellar and compressing the right optic nerve. Its partial removal was followed by rapid restoration of normal function in the right eye.

This case exemplifies the variations which may occur in the train of symptoms associated with suprasellar meningiomas and calls attention to consideration of primary prechiasmal involvement as an entity. It shows why the possibility of such a lesion should be suspected in the presence of an apparent retrobulbar neuritis, even if unilateral, if vision is not restored. The long interval before the right eye was affected demonstrates how slowly meningiomas may grow and, at the same time, illustrates the fallacy of depending on the appearance of field defects in the second eye in the early diagnosis of these lesions. Finally, this case shows the importance of angiography as a diagnostic procedure in a condition which is notable for its lack of positive findings.

Complete Avulsion of Optic Nerve at the Disc: A Case Report. J. W. ROSENTHAL, New Orleans, La. New Orleans M. & S. J. *103*:388-90, March 1951.

The eighth case of this condition, reported in the literature, is presented — its value being in its rarity and that fundus photographs were taken.

Ten years after the original injury, the eye condition was discovered in a 13 year old negro boy. Aside from concomitant exotropia and dilated fixed pupil, the only lesion was in the fundus. The optic disc had been replaced by a large black pigment spot speckled with a pink and white scar. Long, thin, tapering, white and black pigmented glial tissue extended out from all sides of this and into the vitreous, producing a sunburnt effect. The eye had no light perception. The other eye was essentially normal. 7 references. 2 figures.—*Author's abstract.*

Optic Atrophy in Infancy, Childhood and Adolescence. A Survey of 81 Cases. FREDERICK C. CORDES, San Francisco, Calif. Am. Ophthal. Soc. Meet. June 7, 1951.

Optic atrophy in infancy, childhood, and adolescence, although not a common finding, is not rare and is produced by a variety of conditions.

Of the 81 cases reviewed, 43, or approximately 53 per cent, had primary optic atrophy; 32, or 39 per cent, had secondary optic atrophy; 6, or 8 per cent, were the result of retrobulbar neuritis. The percentage of cases of primary optic atrophy was much higher than in Masters' series. This can probably be explained on the basis that many of the cases cited under primary optic atrophy would not have reached a blind school because of early death.

The largest single cause of optic atrophy of all types was hydrocephalus (11 cases), with neoplastic disease second (10 cases). It is interesting that congenital syphilis was third.

Congenital optic atrophy, hydrocephalus, cerebral aplasia, and oxycephaly show optic atrophy in the early age group.

Atrophy due to CNS lues, neoplasms, and trauma were found in the 9-11 year age group.

It is noteworthy that the one case of *meningococcus meningitis* seen in an infant (1 year old) bore out Nettleship's observation that complete blindness is an early manifestation of the disease when it occurs in infants.

Of special interest is the report from the California State School for the Blind stating that the percentage of blind with congenital syphilis has dropped from 7.4 per cent in 1930 to 1.1 per cent in 1950. In 1914 Bishop Harman stated that 56 per cent of the cases of optic atrophy in the London School for the Blind had congenital syphilis. Only one new case of atrophy following central nervous system syphilis has been seen in this age group at the University between 1945 and December 1950.

Exclusive of trauma, 35 per cent of all cases of primary optic atrophy showed mental deficiency, while it was not recorded in the patients with secondary optic atrophy.

From the series of cases presented and the review of the literature, it is apparent that, when attempting to determine the etiology of optic atrophy in infancy, childhood, and adolescence, a great variety of possible causes must be considered.

Visual Field Changes Due to Tumors of the Choroid. WALTER F. DUGGAN, Utica, N. Y. Am. Ophthal. Soc. Meet.*49*: 1951.

The visual fields are rarely mentioned in reported cases of choroidal tumors. Traquair states that the colod field defects are more extensive for blue than for red and that nerve-bundle defects do not occur. Five cases of malignant melanoma of the choroid are presented in which the above-mentioned visual field changes were present. In a case of subretinal hemorrhage, which simulated a melanoma, the field defect for blue was greater than for red; but, unlike the cases of melanoma, a nerve-bundle defect was present for white. This difference may be of importance in distinguishing between cases of melanoma and of pseudotumor due to a subretinal hemorrhage. A case of spasm of three branches of the central retinal artery is included to show that, in a primary retinal lesion, the field defect for red is greater than for blue.

From a study of the color fields, it should be possible, in many instances, to determine whether a lesion is primary in the choroid or in the retina before examining the fundus. In cases where the diagnosis of a fundus lesion is obvious, a study of the fields with both white and colored test objects can contribute to a fuller knowledge of the functions of the choroid and retina.

GLAUCOMA AND HYPOTONY

Surgical Treatment of Glaucoma. A Study of Seventy-Five Consecutive Cases. ELBYRNE G. GILL, Roanoke, Va. Eye, Ear, Nose & Throat Monthly *30*:189-91, April 1951.

In the past 19 years, we have had an opportunity to review the operative work of various surgeons from different medical centers and also to observe the work in various clinics here and abroad. As a result of our observations and experience, we have developed a technic, which, in our hands, gives uniformly good results in the treatment of secondary and chronic glaucoma. The operation performed is iridencleisis.

The operation is indicated in chronic cases and also in secondary glaucoma. Some prefer to use it only in patients with chronic simple glaucoma. We do not hesitate to employ it in any shape of glaucoma.

With this type of operation there is not only the possibility of arresting the disease but also the assurance that few, if any, complications will develop. This assurance is not afforded with the trephine operation, which is often followed by iritis, detachment of the choroid, changes in the lens, and often retarded restoration of the anterior chamber. Iridencleisis can be used in any type of glaucoma.

We have not had any serious complications in our series of cases, nor have we been impressed by this in the hands of others in a review of the literature. Sometimes a mild iritis is present which has never proved serious.

Because of the simplicity and efficiency of the operation herein described, we recommend it to ophthalmologists who are not satisfied with the results they have obtained with other surgical procedures. 2 references. 4 figures.—*Author's abstract.*

Prevention in the Fight against Glaucoma (La prevention dans la lutte contre le glaucome). H. PICHETTE AND J. AUDET. Canada. Laval Med. *16*:597-608, May 1951.

The prevention of glaucoma has recently been exciting considerable interest. Glaucoma is a universal disease, and, in Canada, it accounts for approximately 15 per cent of the total number of the blind. While the three cardinal symptoms of glaucoma are ocular hypertension, changes in the vision, and cupping of the disc, we still should be careful not to confuse ocular hypertension with glaucoma. There are cases of glaucoma without hypertension. Also there are cases of hypertension without alternations in the visual fields, or without cupping of the disc. There also are cases of raised ocular tension and cupping of the discs, without change in the visual field. These diseases with one symptom only might be considered incomplete glaucoma, or an intermediate state before the appearance of the full-blown disease. Glaucoma may show itself in several forms. Possibly the most frequent forms noted are congestive glaucoma and chronic simple glaucoma. However, a case of chronic simple glaucoma may well change to that of congestive glaucoma, or the reverse.

The two common forms of glaucoma are described under symptoms, external examination, changes in tension, visual field, and at the optic disc. A person who has glaucoma and who is not treated becomes blind. If treated the prognosis depends on two factors: the degree of advancement of the disease at the time the patient was first seen, and the adequacy of the treatment. The prognosis is always guarded.

The pathogenesis of glaucoma is not clearly defined at present. The two chief theories are discussed. The first theory is the mechanical theory, which states that the glaucoma depends on the adequacy of the angle of the anterior chamber. Following this theory, cases of glaucoma can be divided into those with wide angles and those with narrow angles. The second theory is the neurovascular theory, which claims the changes in glaucoma result from a neurovascular instability. By this theory it is possible to explain those cases of glaucoma which occur without elevation of tension, and those cases where there is an elevation of tension without other signs of glaucoma.

Let us remember that glaucoma is not a disease of the eye alone, but is merely a local manifestation of general trouble. Widespread changes in vascular stability may be found. The blood pressure, both arterial and venous, should be taken. The patient with glaucoma may be irritable, emotionally unstable, and anxious. An endocrine imbalance may be found. Heredity may be a factor in any given case. One should remember to inquire if the family doctor is giving belladonna to the patient for a systemic disease. If that is found to be the case, the belladonna should be stopped.

Local treatment of glaucoma consists in the giving of miotics. Pilocarpine is still the least irritating and most useful drug. A careful regimen for the installation should be laid down. When the visual field is continuing to decrease, in spite of medical treatment, an operation should be considered. A suprachoroidal, or subconjunctival, fistulization operation is indicated in chronic simple glaucoma.

At the Saint-Sacrement hospital, the second glaucoma clinic in Canada has been established. This has been developed by the Laval University and the Minister of Health of the Province of Quebec. The glaucoma clinic consists of a director, attending

ophthalmologists, a social worker, and a technician. Such a clinic is of distinct advantage. Glaucoma is a disease where many delicate and detailed examinations must be undertaken. Patients who go to a general eye clinic do not get the detailed study that is possible in a special clinic. 5 references. 5 tables.

PHARMACOLOGY, TOXICOLOGY AND THERAPEUTICS

Topical Cortisone in Eye Disease. CARL D. F. JENSEN, Seattle, Wash. Northwest Med. *50*:36-38, Jan. 1951.

Thirteen case studies of patients treated with topical cortisone for a variety of anterior segment eye diseases were reported.

Results of therapy were uniformly good and, in some, dramatically so. A 12 mg./cc. saline suspension of cortisone acetate, merck, was used.

The eye diseases treated were as follows: 7 cases of iritis (1 acute iritis, 2 simple iritis, 2 recurrent iritis, 1 postoperative diabetic iritis, and 1 traumatic iritis); 1 scleritis and sclerosing keratitis; 1 sector episcleritis; 1 advanced pemphigus; 1 allergic conjunctivitis; 1 allergic blepharitis.

Ease, simplicity, low cost, and absence of undesirable side effects are characteristic of cortisone therapy.

Technique of Sphenopalatine Ganglion Therapy for Chorioretinitis. S. L. RUSKIN, New York, N. Y. Eye, Ear, Nose & Throat Monthly *30*:28-31, Jan. 1951.

Nowadays the use of sphenopalatine ganglion block is a recognized and useful therapy, particularly in muscular spastic states and arthritic pains. The use of sphenopalatine ganglion therapy in chorioretinitis has led to improvement in cases which were intractable to other methods of treatment.

The solution used by Ruskin is a procaine-cocaine-ascorbate, containing 1 per cent procaine ascorbate in saturated cocaine concentration. When this solution was applied topically to the nasal ganglion, in a dosage of one-half drop on a Ruskin sphenopalatine applicator, the maximum sphenopalatine ganglion effect could be secured. This applicator is made of delicate, flexible steel so that, when inserted into the middle meatus and carried back to the anterior wall of the sphenoid, the tightly wrapped cotton applicator will cover the area of the sphenopalatine foramen. At this point absorption will be direct and profound. The high concentration of the solution and the very small amount employed give almost a pinpoint application. There is a local blanching because of the concentration which diminishes the tendency for systemic absorption. It is a great error to use dilute solutions or large amounts soaked on a big cotton wad at the end of a heavy applicator. Such crudity is not only ineffective, but also seriously dangerous, because systemic absorption can lead to toxicity. It is likewise important to avoid spraying the solution into the nose or the area of the sphenopalatine ganglion, since, as will be described, the medicament must be continuously under the control of the physician. The moment he sprays the solution, he has lost control of it. He then can only balance his effect by systemic medication, which simultaneously neutralizes the benefit of treatment.

When the applicators are placed correctly in position, the dosage is determined by: (1) evidence of effect on the autonomic nervous system, (2) influence on general muscle tonus, and (3) influence on sensory nerves. These signs must be watched just as the depth of a general anesthesia, and passing or misunderstanding these signs, brings the same untoward results.

In addition to the above solution, Ruskin uses a variety of alkaloids for a special alkaloid effect directly on the sphenopalatine ganglion.

Ruskin advises the inexperienced operator to administer a dose of barbiturate about 15 minutes before giving the treatment and to treat the patient in a reclining position. He cautions against the use of solutions stronger than 10 or 15 per cent. The physician using the treatment should acquaint himself thoroughly with the reactions to be expected to avoid untoward results.

Ruskin routinely uses an intramuscular injection of 5 cc. of calcium ascorbate in one gluteus, and an injection of 1 cc. of ironyl (iron adenosine, 3 monophosphate) mixed with 1 cc. of injectable B complex in the opposite gluteus. These injections reduce and practically eliminate untoward side reactions.

The case reports described are 2 advanced cases of chorioretinitis that were relieved markedly by this therapy. 8 references.—*Author's abstract.*

ILLUMINATION AND ILLUMINATING ENGINEERING

Modern Lighting and Ocular Pathology (Eclairage moderne et pathologie oculaire). E. BLAIS, Canada. L'Union méd. Canada *80*:675-77†, June 1951.

Artificial light presents hazards in that, if it is not properly supplied, ocular difficulties result.

Fluorescent lighting presents a number of advantages. It is more efficient in the production of light than ordinary bulbs and is, therefore, cheaper to run for that reason. The quality of the light is better than that of incandescent light, and different shades can be obtained. It is possible to look directly at fluorescent bulbs with little discomfort. Little heat is produced from fluorescent bulbs.

On the other hand, there are a number of disadvantages to fluorescent lighting. It may cause some glare in the field of vision. A flickering is noticeable when 25 cycle current is used, or when the lamp is defective. It omits a certain amount of ultraviolet light, although this is not enough to be harmful. When moving parts are viewed in its light, there may be a stroboscopic effect; however, this effect can be overcome by using multiple tubes which are out of phase. Finally, the color of objects and people may seem peculiar under fluorescent light.

Several points should be noticed concerning the arrangement of adequate artificial illumination. There should be enough illumination present for the job to be done. This may vary from 10 to 50 foot candles. The light should have a spectral quality within established standards. The spectral quality should approach that of diffuse daylight. The light sources should be so arranged as to give an even illumination with a minimum of shadows and with no sources of the light in the visual field. There should be no great contrast in intensity in the visual field. Fluorescent lighting is not dam-

aging to the vision when properly installed and used, nor should it cause visual fatigue.

Certain diseases of the eye may be attributed to improper lighting, particularly myopia and astigmatism. While errors of refraction may cause a lot of eye trouble, one should remember that ocular fatigue also may be caused by improper illumination.

MISCELLANEOUS

The Effect of Light Absorbing Filters on the Discernibility of a Television Test Pattern. HAROLD STEIN, H. W. HOFSTETTER, AND ROBERT GRAHAM, Los Angeles, Calif., Am. J. Optom. & Arch. Am. Acad. Optom. *28*:19-29, Jan. 1951.

A preliminary investigation was made to determine the effects of a commercially available television filter and a commercially available ophthalmic filter on the relative discernibility of a television test pattern, with and without ambient light present. The discernibility was determined by varying the magnification of an isolated portion of a televised test pattern until the observer could resolve the separate lines.

With ambient light present, most of the 14 observers showed higher relative discernibility with the television filter than without. Without ambient light, no significant differences were obtained.

Eleven of the observers were retested while wearing ophthalmic filters in addition to their regular spectacle correction. No significant differences in relative discernibility were induced by the ophthalmic filter alone, either with or without the ambient light present. When the television filter was in place, the addition of the ophthalmic filter reduced the relative discernibility slightly.

Certain theoretical implications were discussed in the report. 7 figures.—*Author's abstract.*

Changes in Visual Skills of School Children Following Summer Vacation. NEWELL C. KEPHART AND HENRY A. MAZZONI, Lafayette, Ind. Am. J. Optom. & Arch. Am. Acad. Optom. *28*:30-35, Jan. 1951.

Visual skills test data were obtained from children in grades 2 to 11 of a public school. Scores on all 12 subtests of the Ortho-Rater battery were analyzed to determine whether results of tests made following summer vacation differed significantly from results of tests made prior to the vacation period on the same pupils. Mean scores from the first administration of tests of acuity, color, and stereopsis were compared with mean scores obtained from the second testing. Results disclosed that the second means on all the acuity tests and the color discrimination test were significantly greater than were the first obtained means. Means from stereopsis scores did not differ significantly.

Phoria measurements were plotted on scattergrams, which were inspected for evidence of marked shiftings in scores. Only on the far phoriavertical scale was there evidence of considerable shifting, but no general trend could be observed. A comparison of the standard deviations of the distributions of scores on the phoria scales indicated clearly that the scores from the second testing were less variable than those from the first. 4 references, 1 figure, 2 tables.—*Author's abstract.*

A Short History of Spectacles. BENJAMIN L. GORDON, Atlantic City, N. J. J. M. Soc. New Jersey *48*:3-8, Jan. 1951.

The lens, as an instrument for magnifying objects or for concentrating rays to effect combustion, was known at an early period of history. The Greeks were acquainted with the production of images by plane, cylindrical, concave, and convex spherical mirrors.

Books on the subject of refraction date back to the beginning of the Christian era. Early in the second century A. D., Claudius Ptolemy wrote a book on optics, which deals with the refraction of luminous rays in their passage through media of different densities and also with astronomic refractions.

There is no reasonable evidence that either the ancient Egyptians or the Hebrews had any knowledge of spectacles. The Chinese, according to many historians, were the only people of antiquity who developed a knowledge of scientific appliances. Alhazen was the first to correct the Greek misconception of the nature of vision, by proving conclusively that the rays of light come from external objects to the eye and do not issue from the eye and impinge on external things. Alhazen used spherical mirrors and studied spherical aberrations and the magnifying power of lenses, but apparently did not actually originate the idea of spectacles.

Roger Bacon is often credited with the invention of spectacles. The date of the invention was given as the year 1305. Salvinus de Armatus of Florence was probably the first to manufacture spectacles. He came into possession of Bacon's invention through Alessandro della Spina, an indiscreet friend of Bacon's.

Spectacles were first used by the public at the end of the thirteenth century and soon came to be the symbol of scholarship and educational superiority in certain countries.

The fitting and manufacture of spectacles developed speedily in the second half of the nineteenth century. The first box of trial lenses was made by Mr. A. Nacht, and the first physician to construct such an outfit for his own use was C. F. Arlt in 1843. The early trial cases had no cylindrical lenses to correct astigmatic errors, although cylindrical lenses had been used by Thomas Young as far back as 1793.

In 1803 Wallastan introduced the periscopic lens, and in 1847 Donders conceived the idea of prismatic lenses. Their usefulness was tested later by Von Graefe.

Küchler (1843) and Arlt (1844) were the first to introduce letters of different size as standards for determining visual acuity. Ten years later Jaeger published his scale of types, which received general acceptance. Finally, Snellen emerged with his test cards.

The first American contribution to the perfection of spectacles was by Benjamin Franklin (1794) who conceived the idea of splitting two lenses and fixing them in a single frame. This invention led to the invisible bifocal lens.

Dr. Isaac Hays of Philadelphia was the first ophthalmologist in America (1854) credited with prescribing cylindrical lenses to correct astigmatism.

The greatest name in the history of scientific refraction is Hermann Von Helmholtz (1821-1894). He invented the ophthalmoscope and, thereby, revolutionized ophthalmology. 19 references.—*Author's abstract.*

The Battle Against Blindness. W. B. LANCASTER, Boston, Mass. AND F. M. FOOTE, New York, N. Y. J. A. M. A. *145*:26-30, Jan. 6, 1951.

The authors emphasize the importance of blindness as a major public health problem and the need for everyone's help in the battle against it. Last year $125,000,000 was spent for care and services to the blind, while less than $1,000,000 was available for research in blindness diseases. Though activities for the blind are inadequate and should not be reduced, effort to enable persons to keep their sight should be increased, thereby reducing the number of unnecessarily blind.

Causes of blindness and the problems of glaucoma and cataracts are reviewed, past and current progress is described, and future needs are outlined. Citing the work of the National Society for the Prevention of Blindness, the authors conclude, "We believe that the American people will support a properly organized, well-guided and forcefully presented effort to reduce blindness. In this work we shall need the help of every man and woman truly interested in promoting eye health for America." 10 references, 3 figures, 2 tables.—*Author's abstract.*

Ocular Manifestation of Boeck's Sarcoid. Report of Four Cases. AUSTIN G. DUNN AND GEORGE H. ANDERSON, Stevens Point, Wis. Wisconsin M. J. March 1951.

During the past few years many reports and papers have appeared in the literature on ocular localization of Boeck's sarcoid. This might suggest that the disease is becoming more common or that ophthalmologists are becoming more sarcoid-conscious.

The uveal tract — lids, lacrimal glands, conjunctiva, cornea, choroid, and retina — can be involved, and in that order of frequency. Recently it was rather definitely established that uveoparotid fever and Mikulicz syndrome with or without uveitis are classified as sarcoid manifestations.

The uveal tract is the most important region so far as we are concerned. The anterior segment of the uveal tract is the favorite site. During the early stages, the clinical picture is similar to that of many other types of acute iridocyclitis, that is, small pupil, cloudy aqueous, and iris markings obscured by swelling. The most characteristic feature is that the iritis is relatively painless, and the inflammatory reaction is mild as compared with other types of iritis.

It is difficult to differentiate clinically Boeck's sarcoid from tuberculosis iritis, but the latter course is more severe and has a poorer prognosis. The nodules frequently seen resemble the tubercles of tuberculous iritis, but sarcoid nodules are larger, more irregular, and more vascular than in tuberculous iritis. The iritis is usually bilateral, and one eye is more severely involved than the other. In the cases we have observed, we have been impressed with the amount of involvement that has taken place before the patient seeks medical aid. This is probably due to the milder course of the disease. Corneal precipitates and synechia are usually present. Secondary glaucoma and lenticular charges are late manifestations.

Lesions of the lid are usually similar to skin manifestations elsewhere on the face. A wide variety of lesions may occur, that is, infiltrating plaques, nodules, papules, or small tumor masses.

Lacrimal glands may occur as unilateral or bilateral involvement. If it occurs with bilateral involvement of the salivary glands, it is called the syndrome of Mikulicz. Uveitis is usually present, but the condition can occur without the presence of uveitis.

Involvement of this structure is rare, but cases have been reported, and the lesion appears in the form of small nodules.

Lesions in the sclera-cornea-choroid-retina structures are extremely rare, but histologically proved cases have been reported in some of the larger centers. 6 references. 1 figure.

An Approach to Personnel Problems through Visual Performance Tests. R. A. SHERMAN, New York, N. Y. Am. J. Optom. & Arch. Am. Acad. Optom. *28*:92-95, Feb. 1951.

Old concepts of vision, which kept the public from utilizing professional ophthalmic services, have been attacked effectively by a continuing program of research. These investigations have uncovered significant relationships between workers' seeing patterns and their success in their occupations. These relationships show that vision is important to earnings, freedom from accidents, production, and the general well-being of the person.

On the basis of this evidence over 150 universities and colleges are including instruction on the importance of visual performance to job performance. Furthermore, a great many individuals are learning that eyewear can be considered as visual tools rather than crutches to help old or crippled eyes to get along.

In the field of safety, first consideration is given to acquiring that visual performance which is sufficiently good to keep ones' hands, feet, head, and other parts of the body out of situations which cause accidents. Second consideration is given to protection of visual performance by safety eyewear.

Visual Maturation. HOWARD F. HAINES, Columbus, Ohio. Canad. J. Optom. *14*:30-7, April 1951.

Visual development in children is merely one part of their general development or maturation. The stage of development in which we find the child will determine, in many instances, our handling of the case. Refractive errors calling for lens application in young adults may be normal, with lenses contraindicated, for a child of 6 or 7 years. The importance of proper visual hygiene must be stressed.

The child with an unrecognized visual problem may be a poor learner and a serious disciplinary problem.

Children are forced into a pattern of restricted physical activity and relatively prolonged nearpoint fixation based on attained chronologic age, though many of them are neither physically, mentally, or emotionally ready. Over two thirds of 150 unselected first grade children tested were found to be either visually defective or too immature to engage in prolonged nearpoint work.

Most children are apparently born hyperopic. The eye is like a camera that is too

short for the focal length of the lens. Unlike the camera, however, it can, by an effort, put itself in focus; also unlike the camera, it may change itself by this effort to its own detriment. The individual is an adaptive organism trying to conform to his environment; the intelligent, willing child usually makes the greatest effort. This merely hastens his development from hyperopia to emmetropia, or on into a better adaptation at nearpoint myopia. Unfortunately the process is hastened by over anxious and nonunderstanding parents and teachers.

Zoethout and Gullstrand are quoted in corroboration and explanation of myopia induced by nearpoint activity. The point is stressed that each case of myopia is different and must be treated individually. It may be structural, perfectly normal to the individual, and requiring merely the application of minus lenses; pathologic, requiring the attention of the physician; or functional, requiring training or re-education and the use of plus relaxing lenses at nearpoint, or some form of reduced minus — possibly double focus lenses. Reference is made to the work of Stenstrom of Copenhagen, indicating that eyeball length accounts for approximately 56 per cent of the total refractive power of the eye.

Various reports are cited showing the incidence of visual problems in children and the relatively high percentage of failures in the early grades, often 25 per cent or greater, due to failure to meet required reading standards. The question is raised as to whether the fault lies with the children or the failure of educators and parents to gear the child's learning program to his state of maturational progress.

Visual surveys conducted in several schools indicate a very definite variation of visual acuity by age. The standard seems to be 20/30 or better through age 8, 20/20 or better at 9 and over; +1.00 to +2.00D of hyperopia seems to be normal in children of age 5 to 7 or 8, dropping to an average of around +.50D or less at age 9 and over. Myopia appears at approximately age 7 in 10 per cent of the children in one school, increasing to 17 per cent at age 10, and reaches 27 per cent at age 13 and higher.

A refractive error of less than +1.50D would seem to be normal up to age 9, less than +1.00D at age 9 and over. Any myopia, or astigmatism of .50D or greater, should have attention.

At 6 meters any vertical phoria of 1 diopter or greater or any eso or exophoria of as much as 4 or 5 prism diopters should be considered abnormal and referred for a complete refraction. At 40cm. the normal range appears to be from about 3 or 4 prism diopters of esophoria to 9 or 10 of exophoria.

Fusion is the least tangible, the latest to develop, and one of the most important of all functions tested. A binocular individual with low stereopsis is either immature visually or has a visual problem. In the author's practice there is a relatively high correlation between stereopsis and reading ability.—*Author's abstract.*

In regard to the development of myopia, there is no scientific evidence that use of the eyes is a cause. The tendency for myopia to develop during the years of greatest growth and to come to a halt when full growth is attained suggests an endocrine influence. The hereditary factor should also be stressed.—E.B.D.

BOOK REVIEWS

Encyclopedia of the Eye. Diagnosis and Treatment. CONRAD BERENS AND EDWARD SIEGEL, Philadelphia, J. B. Lippincott Co., 1950. 272 pages, 76 illustrations. Price: $5.00.

This text was prepared as a part of the program of the Ophthalmological Foundation for those who wish a ready reference to the diagnosis and treatment of the more common ocular problems. It is believed that physicians, medical students, nurses, and social workers, as well as ophthalmologists and/or optometrists, will find it of considerable value. The encyclopedic form affords a most convenient source of reference.

Brief descriptions of, and the usual treatment for, a great many of the more common eye ailments characterize the book. Included are more extensive sections on pediatric ophthalmology; strabismus; reading disability; and therapeutics. In the latter section there is listed the majority of drugs used in ophthalmology, their indication, and dosage.

This practical, inexpensive, concise book by competent authorities on eye problems frequently encountered in routine practice should be welcomed by ophthalmic practitioners, students, and all those who have a need for reliable up-to-date information on ocular matters.—*Robert E. Bannon.*

References on Vision. Naval Medical Research Institute, Bethesda, Maryland. 4 Vols., March 1943.

As acknowledged in the Introduction, these references are a portion of the file developed over a period of 35 years by Lighting Research Laboratory of General Electric Co., Nela Park, Cleveland, Ohio under the direction of Dr. Matthew Luckiesh and his long-time colleague, the late Lieutenant Commander Frank K. Moss. Dr. Luckiesh authorized the Naval Medical Research Institute to copy this reference file for its use.

The references are indexed according to subjects. Volume I contains references on subjects from Aberrations to Compensation; Volume II, Dominance to Irradiation; Volume III, Kinematics to Ret-Potential; and Volume IV, Scotopic to Vitamin. Many of the references are from the psychological abstracts, ophthalmologic and optometric journals, illuminating engineering journals, and other scientific publications.

This compilation of references on vision and seeing prior to 1943 is useful to research workers, teachers, and writers.—*Robert E. Bannon.*

Essentials of Ophthalmology. ROLAND I. PRITIKIN, Philadelphia, J. P. Lippincott Co., 1950. 561 pages, 215 illustrations. Price: $7.50.

This is an ambitious little book designed to give a fundamental yet comprehensive coverage of the whole field of clinical ophthalmology. The author has had wide experience in this field as a physician, surgeon, writer, and teacher. The text is profusely illustrated by many excellent photographs, figures, and diagrams.

The book begins with the principles of anatomy and physiology of the eye. It includes phases of examination, optics, operative treatment of muscular dysfunction, and the correction of ocular anomalies by means of spectacles. There is a chapter on industrial ophthalmology, and a helpful study of first aid for eye injuries is also included, as well as tables on ocular manifestations of general diseases.

The material presented is intended to provide a handbook of essential information on the eye and its diseases so the physician in general practice may use it in preparing for examinations on the eye.—*Robert E. Bannon.*

Scientific Medical and Technical Books (1945-1948) R. R. HAWKINS. National Research Council. Washington, D. C. Oct. 1950. 514 pages.

This supplement brings up-to-date the first volume, which listed books published during the fifteen years, 1930-1944. As in the original volume, Col. Harold W. Jones, director (ret.) of the Army Medical Library and Editor of *Blakiston's New Gould Medical Dictionary*, is responsible for the selections in medecine and related fields. The list is intelligently classified and contains full descriptive annotations for each title. It bears witness to Dr. Jones' keen judgment and wide experience.

The book contains some 750 titles of immediate interest to physicians; it may well be considered an indispensable tool in book selection for any type of medical library — private or public. Nor will it disappoint the physician looking "for the best book" in some specialty or for a cross-section of the work done in a certain field.

The Editor-in-Chief, R. R. Hawkins of the New York Public Library, is to be congratulated on this new achievement.

Journey Into Light. By ISHBEL ROSS. New York. Appleton-Century-Crofts. 1951. 390 Pages. Price $4.00.

Journey Into Light is the story of the problems, trials and triumphs of the blind throughout the ages. The account begins in the days of Ptoh-hotep in 2650 B.C. when the blind were forced to live as beggars, troubadours, and outcasts. During the slow progress of Christian civilization, man came to realize that the sightless individual possessed other functions undimmed and can, and does, occupy a place in normal industrial, cultural, and professional life.

Helen Keller has written an appreciative foreword such as one has learned to expect from this remarkable person. Part I covers the earliest recorded period of history and presents lively accounts of Didymus of Alexandria, Saint Louis, John Milton, Diderot, and others. Milton's own account of the development of his blindness is certain to interest the ophthalmologist. Part II tells of the life and work of Louis Braille, Samuel Howe, the education of Laura Bridgeman, the accomplishments of Sir Francis Campbell and concludes with an account of the Talking Book, libraries for the blind, etc. Part III treats of the formation of The Lighthouse, St. Dunstan's, and a vivid story of Helen Keller's education and life.

The "Journey" is an accurate account of the lives of the blind who have made outstanding names for themselves and is written in a charming style and with deep feeling, yet without undue sentimentality.

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Abstracts

on

Military and Aviation Ophthalmology

and

Visual Sciences

Conrad Berens, M.D., F.A.C.S.

and

L. Benjamin Sheppard, M.D.

This comprehensive review is being published in the QUARTERLY REVIEW OF OPTHALMOLOGY, in serial form, the first installment appearing in the March, 1951 issue. For the full scope of the material to be presented in subsequent issues, see the complete table of contents in the March issue.

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A[1]. VISUAL REACTION TIME

193. BONNARDEL, R. AND LIBERSON, W.: *Research on the physiology of human work at high altitudes (Recherches sur la physiologie du travail humain aux hautes altitudes)*, Compt. rend. Acad. d. sc., 194 :1265-67, 1942.

These authors found no significant changes in either visual or auditory reaction time on the Jungfraujoch (13,670 feet).

194. BONNARDEL, R. AND LIBERSON, W.: *Experiments on human physiology at high altitudes (Recherches sur la physiologie de l'homme aux hautes altitudes)*, Travail hum. 1 :432-44, 1933.

The simple auditory and visual reaction times of 2 subjects, examined at Paris and at the top of a high mountain in the Alps, were tested. There was no significant difference in either of the two situations. Moreover, there were no perceptible differences at the two altitudes when a prolonged test was given, in which six reactions a minute were taken, with the subject reading the chronoscope dial himself.

195. GARSAUX, P.: *Influence of decreased atmospheric pressure on visual and auditory psychomotor reflexes (influence de la dépression atmosphérique sur les reflexes psychomoteurs visuels et auditifs)*, Compt. rend. Soc. de biol. Paris, 82 :643, 1919.

The author measured psychomotor visual and auditory reaction times (reflexes) at altitudes from 1,000 to 6,000 meters with and without the use of oxygen. The reaction times up to 3,500 meters with and without oxygen were approximately equal in time and regularity to those at ground level. Visual and auditory reaction times at 4,000 meters and over were slower and more irregular in those subjects who had no oxygen equipment, but remained approximately the same as at ground level in the subjects using respiratory apparatus.

196. GELLHORN, E.: *The effect of O_2 lack, variations in the CO_2 content of the inspired air, and hyperpnea on visual intensity discrimination*, Am. J. Physiol. 115 :679-84, 1936.

The author concludes as follows: O_2 lack (8-10 per cent O_2- N_2 mixtures), 6 per cent CO_2- air mixtures and hyperpnea produce a reversible decrease in visual intensity discrimination. The magnitude of the change and the duration of the recovery depends on the degree of O_2 lack. Under all three conditions a supernormal phase is sometimes observed after the admission of air. The experiments prove that the excitability of the visual and (any auditory) apparatus is influenced in a similar manner by hyperpnea, O_2 lack and CO_2 excess. 14 references.

197. GELLHORN, E.: *The effectiveness of carbon dioxide in combatting the changes in visual intensity discrimination produced by oxygen deficiency*, Am. J. Physiol. 117 :75-78, 1936.

The effect of breathing 8 to 9 per cent oxygen on the visual intensity discrimination in man can be either completely removed or greatly diminished by small concentrations of CO_2 (3 per cent), which in themselves have no effect on the sensory function investigated.

It is believed that this effect is due to the circulatory improvement induced by CO_2 under oxygen deficiency.

Carbon dioxide causes a dilatation of cerebral vessels, thereby improving the circulation and the function of the brain.

The CO_2 effect is due to the shift to the right of the oxygen dissociation curve of the blood; thereby increasing the rate at which oxygen is given off to the tissues.

It is also due to the improved muscular tonus, resulting even from small concentrations of CO_2, which increases the venous return to the heart.

Small amounts of CO_2, which in themselves are without influence on blood pressure of anesthetized dogs, produce in the presence of oxygen deficiency a distinct increase in blood pressure.

198. JONGBLOED, J.: *Mental behavior during a short stay at an altitude of 5,000 meters (Ueber das psychische Verhalten während kurzen Aufenthalts auf 5,000 Meter Höhe)*, Klin. Wchnschr. 14 :1564-68, 1935.

Visual stimuli were used to test young healthy students with no altitude experience for physical effects of altitude. The simple reaction time is not changed much at 5,000 meters altitude. Choice reaction time is definitely longer. The regularity of simple reaction time is slightly impaired by a longer stay at 5,000 meters. Oxygen breathing does not always shorten the reaction time.

199. TANAKA, K.: *Experimental study on the effect of low barometric pressure and oxygen deprivation upon the efficiency of mental and physical work*, Rep. Aero. Res. Inst., Tokyo, No. 37 :127-230, 1928.

Simple reaction times to visual stimuli were measured by the D'Arsonval chronoscope. All reactions show a gradual retardation up to 15,000 feet and then a sudden sharper retardation. Choice reaction time was affected most; visual reaction time the least.

See also: No. 75, Wilmer & Berens, 1918; No. 165, Beyne, 1928; No. 179, Wilmer, 1918; No. 984, Dunlap, 1918.

IX. Aniseikonia

200. Ames, A., Jr.: *Aniseikonia—a factor in the functioning of vision,* Am. J. Ophth. 18 :1014-20, 1935.

The spatial relationship of objects to one another and to ourselves is made known to us through perspective and through our stereoscopic sense. In the judgment of depth this sense is very accurate in us. Stereoscopic vision is also of greatest importance as affecting our visual judgment of the position of groups of objects taken as a whole, planes or surfaces; that is, the bearing of stereoscopic vision as affecting our judgment of extended fields of view, rather than foveal or parafoveal imaged objects only.

This important type of visual interpretation is affected by aniseikonia (the relative size and shape of our ocular images) and also by the declinations of the retinal meridians.

The question arises, if false stereoscopic interpretation of the position of surfaces exists in cases in which aniseikonia is of long standing, or if those suffering from aniseikonia learn through experience to make compensation for false impressions received by them.

Patients were tested on the tilting field, after their aniseikonia had been measured and corrected on the ophthalmo-eikonometer. Forty-eight per cent reported marked relief and 29 per cent partial relief from wearing iseikonic prescriptons. Twelve per cent were failures and 11 per cent undeterminate. Persons affected by aniseikonia only slightly or not at all interpret the orientation of surfaces, planes, and groups of objects taken as a whole correctly through their perspective sense, whereas patients with aniseikonia falsely interpret the above. The extent to which their total visual judgment is affected by their false stereoscopic sense depends on the predominance of perspective features in the field of view.

201. Ogle, K. N.: *Induced size effect. I. A new phenomenon in binocular space perception associated with the relative sizes of the images of the two eyes,* Arch. Ophth. 20 :604-23, 1938.

For geometric reasons, together with the fact that the stereoscopic function exists in the horizontal meridian, one might anticipate a change in the apparent rotational position of a surface seen binocularly when a change is introduced in the relative sizes of the images of the eyes in the horizontal meridian. The results with a complex pattern veritfy this expectation.

However, the induced effect which is the phenomenon of the apparent rotation of the binocular visual field caused by a difference in the sizes of the images in the vertical meridian, is a new and unexpected phenomenon.

Its functional basis is not clear, since no stereoscopic depth perception is known to originate from disparities of retinal images in the vertical meridian. Three data are of importance in regard to this phenomenon: (1) a one to one ratio of the maximum sensitivities of the induced to the geometric effects exists, though the two effects are opposite in sign; (2) the effect reaches a maximum value for differences in the sizes of the images in the vertical meridian greater than 5 or 6 per cent; (3) above this difference the induced effect decreases slowly.

Only a conjecture as to the nature of this phenomenon is possible.

The only allied phenomenon is the apparent change in the sizes of the ocular images found when the eyes are turned in asymmetric convergence, where apparently a compensatory process occurs, which offsets the retinal difference in the sizes of the images that would arise because of the difference in the distances from the object to the two eyes.

202. SCHUBERT, G.: *The problem of aniseikonia in examinations regarding qualification of aviators (Das Aniseikonieproblem bei Fliegertauglichkeitsprüfungen).* Luftfahrtmed. 4 :285-91, 1939-40.

In artificially produced aniseikonia, an illusion is caused by Ames' "tilting field," which renders it necessary to place a movable plate slantwise in order to make it appear parallel to a fixed control (reference) surface. On the basis of this illusion, Ames, Bielschowsky, and others attribute vital importance to aniseikonia in landing maneuvers of airplanes, upholding that aniseikonia is a special abnormality in the function of vision. The author proves that the tilting field phenomenon is also observed in cases of physiologic aniseikonia, i.e., during observation made under the influence of asymmetrical convergence. The cause of this illusion is not explicable. However, the author proves that this arises only under conditions of observation which never occur in aviation. Therefore, the author opposes the use of the tilting field, as well as other similar testing arrangements, for the proof of such disturbances of visual functions, because even a person with normal binocular vision shows exactly the same disturbances. The methods of Ames, Ogle and Gliddon are considered entirely unsuitable for examinations *en masse*.

Anyway, typical cases of aniseikonia invariably show such disturbances of function that they will easily be detected in applying the regular prescribed visual examination, especially the one for depth perception.

See also: No. 298, Boeder, 1938.

X. Anoxia

See: altitude—anoxia.

XI. Autokinetic Movements

203. SHERIF, M.: *The psychology of social norms.* New York and London, Harper & Brothers, 1936.

Adams (H. F.: Autokinetic sensations, Psychol. Monog. No. 59: 32-44, July, 1912) gave a concise history of the autokinetic effect as a scientific problem.

The author states that "the autokinetic effect is produced whenever a visual stimulus object lacks a spatial frame of reference."

The autokinetic effect can be produced experimentally. "In complete darkness, such as is found in a closed room that is not illuminated, or on a cloudy night in the open when there are no other lights visible, a single small light seems to move, and it may

appear to move erratically in all directions. If you present the point of light repeatedly to a person, he may see the light appearing at different places in the room each time, especially if he does not know the distance between himself and the light.

203a. TROLAND, L. T.: *Vision. 1. Visual phenomena and their stimulus correlations, in A Handbook of General Experimental Psychology, edited by Carl Murchison, Worcester, Mass.*, Clark University Press, 1934, p. 697.

Illusions of motion frequently appear when the external world is imperfectly represented. "An isolated bright spot against a wholly dark field shows random drifting movements—'the autokinetic sensation'—even when it is quite fixated."

XII. Bends

See: decompression.

XIII. Bibliographies on Aviation Medicine

204. ANON.: *Bibliography of Aeronautics, Part II—Medicine*, U. S. Works Progress Administration, 1937, 113 pp.

This bibliography was compiled from the index of aeronautics of the Institute of Aeronautical Sciences.

It is an extensive bibliography covering accidents, airsickness, airplane ambulances, carbon monoxide poisoning, cardiovascular system, ear, nose and throat, effects of altitude, effects of wind, cold and speed, eye fatigue and staleness, hygiene, nervous system, pathology, physical qualifications, psychologic aspects, psychophysiologic aspects, sanitary aviation, and general references.

205. ANON.: *Bibliography of aeronautics—Supplement to Part II—Medicine*, U. S. Works Progress Administration, 1940, 97 pp. Mimeographed.

One hundred and sixty-four titles of papers, published in periodicals, in English, Spanish, Portugese, French, German, Italian, Russian and Polish are quoted. All of the Japanese articles were written in, or translated into, German. These papers are almost exclusively on depth perception and influence of hypotension on human eye.

Some of the titles of articles treating rather unusual subjects are: Letter to Major Hargreaves; Use of parsley against night-blindness; Flight Surgeon Topics, Randolph Field, Texas, (Oct.) 1938, Vol. 2, No. 4, p. 239.

The influence of acoustic stimulation on color sensibility of a protanopic eye. S. F. Kravkov. Acta Ophthalmologica, Copenhagen, 1937, Vol. 15, No. 3, pp. 337-42.

(In German): Can color-confusion be improved by the use of neophan glasses? Lindeman, H. O. Klinische Monatsblätter f. Augenheilkunde, Stuttgart, (Au.) 1937, Vol. 99, pp. 224-29.

A simple (lantern) apparatus for precise (accurate) examination of red-green and blue-yellow disturbances, including the color thresholds in light-sense tests. Oloff, H. F. L. Same journal: pp. 216-23.

Abridged description of the results of tests made with new Stilling-Hertel color samples for examination of the color-sense. Caanitz, H. and Heinsius, E., Der deutsche Militärarzt, Berlin, (Nov.) 1939 Vol. 4, No. 11, pp. 496-97.

Another kind of Blackout, Lancet, Lond., (Nov. 25) 1939, Vol. 2, No. 22, pp. 1125-26 (in English).

The influence of hyperventilation and of variations of oxygen and carbon dioxide tension in the inspired air upon galvanic nystagmus. Gellhorn, E.: Acta Oto-Laryngologica, Stockholm, 1938, Vol. 26, No. 4, pp. 387-401.

A theory of retino-cerebral function with formulae for threshold vision and adaptation at the fovea. Elsberg, C. A. and Spotnitz, H.: American Journal of Physiology, Baltimore, Md., (Feb. 1) 1938, Vol. 121, No. 2, pp. 454-64.

206. Apostol, O.: Index bibliographica medicinae aeronauticae, 1934, pp. 12.

207. Beyne, P. J. E.: *Bibliographic indications, with regard to medico-aeronautical questions (Indications bibliographiques au sujet des question médico-aéronautiques)*. Arch. de méd. et pharm. mil., 80 :482-97, 1924.

This volume includes 399 references to medico-aeronautical questions.

208. Boissay, C.: *Aeronautic bibliography (Bibliographie aéronautique)*. Nature, Paris, 2(2) :270, 1874.

No reference is made to the eye.

The author stated that nearly all official documents referring to aeronautics during the siege of Paris in 1870-1871 have been destroyed by fire in the Château de l'Etoile, Paris. Eight titles of books on balloon ascents and aërial navigation are given.

209. Konopka, St.: *Aviation and medicine; bibliography for year 1935*, Warsaw, 1937, pp. 104.

This bibliography contains 313 references. The former issue consisted of only 186 items, which proves that the interest in aviation medicine is steadily growing in all countries.

210. McFarland, R. A.: *A bibliography on the selection, training, and physical fitness of aviation pilots*. National Research Council Committee on the Selection and Training of Civilian Pilots and the Civil Aeronautics Authority, Washington, D. C., December, 1939, pp. 49.

This is an extensive bibliography covering the following subjects: psychologic studies,

sensory tests, physiologic studies, the effects of moderate and high altitudes, medical examinations and tests of physical fitness, human factors in airplane accidents, and a list of aeronautical journals.

211. SCHMIDT, I.: *Bibliography of aviation medicine (Bibliographie der Luftfahrtmedizin). Berlin,* J. Springer, 1938, pp. 136.

Titles of papers are given: Under II. Psychophysiology of aviation, sub B on page 7, under the heading of "visual organ": 49 references, 33 of which are in English. Sub E, on page 13, under the heading of "blind flying": 16 references are given, 8 of which are in English.

This biblography includes literature to the end of 1936.

212. *U. S. National Advisory Committee for Aeronautics: Bibliography of aeronautics, 1909-1932,* Washington, D. C., Government Printing Office, 1921-36, 14 vols.

Bibliography of aeronautics (1909-1916 inclusive) is presented by Paul Brockett, quoting the titles of current publications, together with the periodicals in which they had been published (in English and foreign languages); the second volume treating titles of articles published during or after the First World War (1917-1919). The third volume is dated 1922, and so on (in rotation) until 1932. In the first volume no division is devoted to medicine, but there are articles mentioned on orientation. From the second volume, articles on medicine are indexed only occasionally. However, in most cases there are no subdivisions, such as "Eyes."

Titles of articles enumerated under "Eyes": In the second volume (1917-19) one title in English: "Sharp American eyes high in the sky keeping close and constant watch on German trenches 'over there'." Official Bulletin, Vol. 1, No. 187, (Dec. 18) 1917, Washington.

In 1928 there is one title mentioned under the heading of eyes (in Italian): Talenti, C.: "Influence of colored light on retinal adaptation." IV. Internat. Congr. of Air Navigation, Rome, 1927, 24-30. Vol. IV. Rome, 1928, pp. 645-57.

In 1930 and 1931 there are two articles (one each) in English: Deed's, Ed.: "Mist in the pilot's eyes," The Sportsman Pilot, Vol. 4, (Dec.) 1930, New York, pp. 18-19, and McCrane, L. H.: "Eyes—how to correct them," Western Flying, Vol. 9, (Jan.) 1931, Los Angeles, Calif., pp. 32-34.

See also: No. 912, Beyne, 1939.

XIV. Black-Out

See: acceleration-decelaration; black-out—red-out.

XV. Blind Flying

213. ANON.: *A note on blind flying issued by the Aeronautics Branch, Department of Commerce,* J. Aviation Med. 5:26-27, 1934.

As a result of a series of blind airplane-spin tests, an interesting physical phenomenon has been demonstrated in a number of pilots. If a pilot sits in a normal manner with head erect, facing forward, he is subject to only slight, if any, false impressions of position and orientation. If, however, his head is twisted or inclined sidewise, he is immediately subjected to strong, entirely false impressions of position and orientation. For those who experience difficulty in overcoming the conflict between their sensations and the indications of their instruments, it is believed that to sit straight will be a decided aid.

Wider circulation of these facts, particularly to their bearing on instrument flight, may tend to facilitate and promote safety.

The semicircular canals, three on each side, are elliptical, horseshoe-shaped tubes, located deeply within the skull bones laterally, behind the cochlea. They are sense organs for equilibrium and orientation.

214. ANON.: *Wright Field Information: History in brief of Material Division*, J. Aviation Med. 9:124-36, 1938.

The first practical system for accomplishing blind flying was developed at the material division; it was demonstrated in 1932 by Captain A. F. Hegenberger.

The automatic landing was achieved for the first time in history, August 23, 1937. Captain C. J. Crane was in charge of the development.

215. ANON.: *The Metcalf blind landing system for airplanes*, Science, 89 (Suppl. 2306): 8-9, 1939.

Perfection of a virtually foolproof blind landing system for airplanes seems assured, following tests of major elements in a new radio-beam method at East Boston airport.

Radio microwaves, only 17 inches long, provide a straight, staticfree path, down which an airplane can make a normal "straight" landing glide to land in the middle of the runway, independent of weather and darkness.

In actual flying tests, three lighted dots in a cathode ray tube instrument on the pilot's dashboard tell him wether he is on course or in what way his position is wrong. When the three lights are lined up horizontally (the middle dot being properly centered), the plane is on course.

In the Metcalf method the signals are not reflected from the ground and, hence, are independent of ground conditions. Because the instrument follows the relative strengths of four signals sent out by the same transmitter, the absolute volume of the four signals makes no difference.

216. ARKHANGELSKIY, A.: *The use of psychophysiology in training for blind flying*. Vo.-sanit. Dyelo, No. 1:86-89, 1935.

The main point of the paper is a plea for ground-training of the pilot in blind flying. He pointed out that in a fog the pilot holds the horizon in his memory only four or five minutes; also experiments in the rotating blind cabin show that the "counter-rotation illusion"

lasts from 14 to 18 seconds. This illusion is due to inverse motion of the endolymph in the semicircular canals of the ear.

The author described exercises in which the candidate records by hand-clutch and pedal instruments his reactions to rotation, which show him that his own sensations are not trustworthy, and which train him to depend closely on his instrument board in blind flying.

217. BAUER, L. H.: *Symposium on blind flying—introduction*, J. Aviation Med 1:127-32, 1930.

Blind flying is defined as flying without a horizon for guidance which occurs in fogs, clouds, and thick weather. It may be simulated by flying under a hooded cockpit. W. C. Ocker (see No. 225, Ocker, 1930) states the necessity of flight in spite of weather, if air transportation is to be advantageous and a commercial success. He further stated "one of the principal difficulties in flying blind is that the pilot experiences certain fatiguing stimuli, which make for hazardous flight because the efficiency of the person is enormously reduced. This fatigue is the result of a number of causes and subcauses: one, the pilot's normal sense of equilibrium while he is flying by the indications of the instruments; the second cause is a mental condition of strain and the continuous necessity of fast, accurate thinking."

Vertigo is not only confusing but causes false sensations of direction which are not so well understood by the laity, at least. However, that such is the case can be easily demonstrated by a Bárány, or other, turning-chair. For example, if the applicant is turned to the right with his eyes closed, 10 times in 20 seconds, he at first has a sensation of turning to the left, then a sensation of turning to the right, and if the turning rate is then slowed or stopped altogether, he again has the sensation of turning to the left. If he opens his eyes, the falsity of his sensations is at once apparent. The cause of these sensations is due to stimulations of the end organs of the vestibular branch of the eighth nerve in the semicircular canals.

W. C. Ocker and Myers then devised a black box of a camera type into which the subject could look while being turned instead of closing his eyes. Certain flight instruments were placed in the bottom of the box. The subject can then tell what information his sensations give him and also what the instruments told him. Then by having him look up from time to time it is easy to convince him that his sensations are wrong and the instruments right. The pilot must be shown that he can never trust these sensations unless he has a horizon with which to check.

If a pilot flying in a fog goes into a spin and then comes out, he has the sensation of spinning in the opposite direction. If he depends on this sensation he will correct for the supposed spin and this "correction" at once puts him into another spin. This may keep up in a vicious circle until he crashes. His only hope is to disregard his sensations and fly by instruments. To follow one's instruments is difficult without special training because these erroneous sensations one receives are overpowering until one has been trained to disregard them.

Bauer quoted W. C. Ocker (abstract no. 225): "When these illusions, the result of vertigo, obtain in the air, the pilot follows them unless he has been trained to disregard them. While flying without outside visual reference, even though with reliable flight instruments,

the untrained pilot frequently reverts to his sense of feel or balance and controls the airplane in response to erroneous impulses. The result is too often disastrous. The pilot properly trained to fly by instruments alone is still handicapped by vertigo, although he is able to counteract this effect by relying on the instruments supplied for his guidance. Yet the pilot's reaction to this very physical stimulus of vertigo caused by the workings of the inner ear is one of the principal factors producing fatigue while flying blind.

"That portion of fatigue associated with mental or psychologic conditions may be explained as follows: normally at least three instruments are placed on the instrument board in the pilot's cockpit to supply him with necessary information for conducting his flight when he is deprived of outside visual reference. Usually the instruments he watches bear little resemblance to the things he sees while flying in clear weather. These instruments indicate such conditions as direction, rate of turn, the angle and rate of climb and the lateral position of the aircraft. They do this in a manner that requires interpretation on the part of the pilot. This interpretation of instruments is a fatiguing intellectual process, for there are very few subconscious reactions on the part of the pilot to instrument indications.

"To overcome this situation, W. C. Ocker and Crane devised an instrument known as a flight integrator, which combines the necessary instruments in one instrument and is superior to anything yet suggested. As flight surgeons and medical examiners we can do our bit in furthering this work by demonstrating to pilots and students the faulty sensations that blind turning will cause. A Bárány or ordinary office revolving chair may be used for this purpose."

In a personal letter to Bauer, Ocker stated, "Experiments at North Island, California, with Navy pilots, prove that if the pilot is thoroughly familiar with the reasons why he must fly by instruments, he will not revert to flying by instinct or sense of feel if the cover is opened while the machine is flying in fog."

218. Crane, C. J. and Ocker, W. C.: *A flight integrator*, J. Aviation Med. 1: 150-53, 1930.

It has been definitely proved by W. C. Ocker that a pilot using present flight instruments will suffer from vertigo in the absence of external terrestrial or astronomic reference, due to movements of the aircraft.

The integrator includes a casing or support to be mounted on the instrument board or otherwise affixed to the aircraft and supports an improved integrating turn indicator apparatus, including a belt or screen, and power unit in the nature of a motor and a gyroscopic apparatus for controlling the operation of the motor.

As a result of the authors' experiences and research, improvements were devised to facilitate aerial flight, particularly an integrating device and co-related series of instruments in such arrangement as will enable proper control and flight of an aircraft by "blind" or "instrument" flying.

Numerous instruments have heretofore been provided as an aid to the pilots of aircraft for the purpose of indicating or seeking to indicate the attitude of the aircraft without external visual reference.

219. Crocce, A.: *Instrument flying (Le vol aux instruments)*. Rev. Armée Air 8:1085-1104, 1936.

Beginning with the statement that in flight the interval of utilization of the angle of incidence may not exceed 12 degrees without jeopardizing the safety of the plane, the author examined in detail the sensations of the aviator, sensations originating in the ear. He listed six interdependents responsible for equilibrium; three movements of center of gravity (speed in three axes of direction) and three oscillations around center of gravity (pitch, roll, yaw). The instruments evolved by man to determine position of the plane in the air register speed of movement and the three angles which fix position in space. Instrument flying can be reduced to watching three instruments, since the speed can be regulated by the flow of gas.

220. Jones, I. H.: *Blind flying*. J. Aviation Med. 5 :137-44, 1934.

The turning test simply demonstrates whether a candidate is unduly hypoactive or hyperactive.

It is most important for the pilot to understand his vestibular sense, because of the illusions which have disturbed every single individual who has ever gone up into the air. A serious thing for a pilot is not to understand these illusions when he cannot see.

The "Ocker instrument box on the Jones turning chair" will enlighten any pilot; first with the light not turned on in the box, later lighting the instruments inside the box. If this is done several times, any pilot can understand the essentials of his vestibular mechanism.

The next step is actual flying under the hood. The ideal would be to learn to fly blind before the student pilot has had any other instruction.

The "artificial horizon" makes blind flying safe.

All that is needed now is for the pilot to correlate his own sensations with the instruments.

221. Jones, I. H. and Ocker, W. C.: *Flying blind—study in physiology of eighth nerve*. Laryngoscope 45: 405-20, 1935.

Any student pilot should be taught to fly blind before getting the usual flying instruction. Every pilot will understand the essentials of his vestibular sense after very short instruction.

The composite of motion-sensing is made up of the visual sense; besides the proprioceptors ("deep sensibility"); the tactile sense; and the vestibular sense. Vision, most important in sensing motion on the ground, suffers impairment of usefulness in the air, because of the pilot being far removed from all details of visible objects. When further reduced by darkness, clouds or fog, this sense becomes eliminated as a source of guiding information.

Tactile sense is relatively unimportant in motion-sensing, but the vestibular sense suffers no depreciation in the air. The actual "motion-detector" is the internal ear.

222. LEVY, H. H.: *Latest developments in blind flying*, South. Aviation, Atlanta 2:7-9, 1930.

Reference is made to the experiments conducted under William C. Ocker. His method consisted in convincing the subject that the senses of the latter, when flying blind, are not only of no help, but actually a constant threat against his own life, and to teach him to move his hands and feet in accordance with what he sees on the instrument panel, instead of what he observes outside the cockpit. A certain amount of training is necessary in order to readjust the reflexes of the student.

A box invented by Ocker plays an important part in training the student aviator. When the face of the student is pressed close to an aperture in the front of the box, the subject can see only the model instrument panel inside. This simulates conditions he would meet in flying in a fog. Regular flights in a plane with a covered cockpit follow the preliminary instruction with the box. Flying a triangular course of 155 miles under a covered cockpit, guided entirely by instruments, is the final test of the curriculum at the Advanced Training School at Kelly Field.

223. MYERS, D. A.: *The medical contribution to the development of blind flying*, Army M. Bull. 36 :18-37, 1936.

The cooperation of sight, muscle, and vestibular sense chiefly maintain equilibrium. Much of the integrating adjustment of these sense organs is lost in the air. The vestibular sense requires the most checking by the other two senses. Although the efficiency of vision and muscle sense may be decreased in the air, they do not give false impressions.

224. OCKER, W. C.: Blind flying, J. Aviation Med. 1 :132-150, 1930.

Ocker prepared a light-tight box in which was mounted a bank and turn indicator, compass, and flashlight for viewing the instruments through an aperture designed to fit tightly against the face. The test was then repeated. With the aid of the device, he was able to state the direction of rotation and any change of rapidity.

The bank indicator and turn indicator are combined in such a manner that they both record within a small circular disk and may, therefore, be observed at practically a glance. Equilibrium is maintained by coordination within the brain of stimuli received from the special senses.

The special senses are the sense of sight, vestibular sense, deep muscle sense, and tactile sense. This special sense of sight is recognized by all as the most important factor in our existence on earth. This special sense is not infallible, for we often hear of mirage and optical illusions; but it is, indeed, the most valuable and most reliable of all the special senses of equilibrium.

Equilibrium in flying depends first on the sense of sight, then on vestibular senses, deep muscle sense, and, least of all, on tactile sense.

In blind flying, our last resort, the sense of sight, also fails, for there is no horizon to show the position of the earth. Without a horizon, or a substitute, the aviator is helpless.

An artificial horizon would be an imaginary one formed by instruments, with the bank and turn indicator as the key instrument and such other instruments as will quickly and reliably inform the pilot of the altitude of the plane in relation to the earth's surface. The bank and turn indicator, American or foreign, show any change in position of the airplane in relation to the ground in the two planes in which it functions. Guided by the readings of this instrument, a pilot can maintain an airplane on an even keel and a straight forward course, if the ball of the bank indicator and the pointer of the turn indicator are both kept in the neutral position.

The bank and turn indicator fails to furnish any information as to position of the airplane in a plane perpendicular to the earth. It is, therefore, necessary for the pilot to resort to other instruments, the rate of climb indicator or the inclinometer and the altimeter for such information.

225. OCKER, W. C.: *Economic value of flying by instruments,* Aero Dig. 17 :62-63, 1930.

See: No. 217, Bauer, 1930.

226. OCKER, W. C. AND CRANE, C. J.: *Blind flight in theory and practice,* San Antonio, Texas, Naylor Printing Co. 1932, pp. 200.

Blind flying means just one thing: flying an airplane while unable to see the natural instrument (which is visual reference of terrestrial or astronomic objects) sufficiently in detail to establish a plane of reference that bears a known relation to the earth's surface, which is the means by which every pilot controls his craft. There are other aids to manual flight control, but there is no substitute for visual reference.

227. PETERSEN, O.: *The effective arrangement of instruments for blind flying (Ueber die Sinnfälligkeit von Blindflugmessgeräten),* Indust. Psychotech. 16 :225-39, 1939.

Most of the airplane controls are adapted to natural changes in bodily posture except the moving indicators, such as the compass.

In an experiment with 20 subjects on all levels of flying experience, it was determined from reaction-time study that a specially constructed compass of a different type is more suitable. This apparently also applied to the device indicating change of direction.

228. POPOV, A.: *Professional selection and ground training for blind flying,* Vo.-sanit. Dyelo. 2-3 :64-69, 1936. Abstract: J. Aviation Med. 7 :212, 1936.

Whereas his senses (especially sight) permit the normal aviator orientation in space, this is not possible in mist, clouds, or blind-flight. Chiloff is of the opinion that the vestibular apparatus has but slight importance in space orientation during figure flying and spins with great centrifugal accelerations. On the other hand, the internal ear plays a significant part in ordinary flight or blind flight. Accordingly, only such pilots should be chosen for

blind flying as show an organ very sensitive to slight changes in position and direction. All pilots should nevertheless be trained to fly by instruments and not rely on their senses. Ground training in special cabins (Link) with all apparatus and instruments for blind flying is recommended. The pilot is finally trained to rely wholly on instruments.

229. POPPEN, J. R.: *Equilibratory functions in instrument flying.* J. Aviation Med. 7 :148-60, 1936.

In considering spatial relationships between man and his environment, the distinction between equilibrium and orientation should be kept in mind. In the discussion reference is made to tests with the Jones-Bárány chair and devices attached thereto.

Muscle sense, skin pressure sense, so-called "seat sense" furnish valuable information in keeping an airplane in proper flying attitude.

Instrument flying and "blind flying" are discussed. The latter denomination is objected to by the author.

The keynote of instrument flying is that we must not only disregard our natural feelings but deny them. It is most difficult to convince oneself that mechanical man-made instruments are correct, when they indicate situations "felt" by us to be wrong.

More attention than heretofore should be paid to the illumination of flying instruments.

230. WINTERS, S. R.: *Mechanical aids for testing prospective pilots.* South. Aviation No. 5 :27, 1930.

Winters described a revolving chair which, when used with the instruments for blind flying, can be employed in training pilots to depend on these instruments.

See also: No. 5, Diringshofen, 1939; No. 16, Diringshofen, 1940; No. 175, Schubert, 1931-32; No. 762 and 763, Jones, 1937; No. 1126, Greene, 1940.

See also: spatial orientation; equilibrium.

XVI. Caisson Disease

See: decompression.

XVII. Carbon Dioxide

See: No. 122, McFarland & Dill, 1938; No. 134, Gellhorn & Spiesman, 1935; No. 196, Gellhorn, 1936; No. 197, Gellhorn, 1936.

XVIII. Carbon Monoxide

231. LEVY-VALENSI: *Amaurosis from carbon monoxide poisoning (Un cas d'amaurosis par intoxication oxycarbonée).* Bull. et mém. Soc. méd. d. hôp. de Paris 48 :382-84, 1924.

The patient, probably attempting suicide, exposed himself to carbon monoxide. The

ophthalmoscopic diagnosis was: secondary optic neuritis, partial disk discoloration, more advanced in the right eye and 2/100 vision.

It does not seem to be a clean-cut case because in the discussion Dr. Rist said that according to him the patient's eye grounds were practically normal and that he was a malingerer.—*Bruno Priestly, M.D.*

232. PILMAN, N.: *Changes in field of vision due to chronic carbon monoxide poisoning,* Sovet. vestnik oftal. 4 :433-40, 1934.

233. PILMAN, N. I. AND TARADINA, N. A.: *Xanthopsia due to chronic carbon monoxide poisoning,* Sovet. vestnik oftal. 7 :903-907, 1935.

234. SHARTS, S. E.: *Ocular manifestations of carbon monoxide poisoning,* Vestnik oftal. 12 :370-76, 1938.

235. WECHSLER, I. S.: *Carbon monoxide poisoning followed by cortical blindness with conservation of color perception (Cécité corticale avec conservation de la vision colorée, consecutive à une intoxication par l'oxyde de carbone. La question de la vision colorée, de l'agnosie des couleurs et de leur localisation),* Rev. Neurol. 2 :490, 1931.

This is a summary presented at a meeting of the International Neurological Congress at Bern.

236. WECHSLER, I. S.: *Partial cortical blindness with preservation of color vision; report of case following asphyxia (carbon monoxide poisoning?); consideration of question of color vision and its cortical localization,* Arch. Ophth. 9 :957-65, 1933.

From the analysis of the case reported the assumption is justified that the lesion was predominantly, though not exclusively, cortical. Bearing in mind the cortical type of blindness (bilateral temporal), the cortical type of sensory loss (parietal), the mental deterioration (frontal lobes), and the early convulsions, it would seem as if the whole cortex had been affected.

One question is raised: that is, if color vision resides in the cortex and the surface of the brain was destroyed by the pathologic process, color vision should have been lost and not retained.

See also: No. 346, White, 1932; No. 874, Trexler, 1938.

See also: diseases—carbon monoxide poisoning.

XIX. Cold, Effect of, on the Eye

237. COLOMBO, G. L.: *Bilateral changes in the cornea of the flier caused by cold (Alterazione bilaterale "a frigore" della cornea in aviatore),* Pathologica 11 :279-83, 1919.

A pathologic corneal lesion caused by intense cold occurring in an aviator is described.

The aviator had remained at approximately 25 degrees below zero for three hours during flight. The protective reflexes were impaired by the cold.

238. ROGER, H.: *Physiology of the aviator (Physiologie de l'aviateur).* Presse méd. 48 :606-609, 1940.

At 24,000 m., temperature reaches 55 degrees C. The author reported that as zero is approached, painful numbness is felt in the hands and fingers. At minus 23 degrees visual disturbances are observed. Physical and mental depression occurs at between minus 34 and 40 degrees.

See also: No. 87, Gallenga, 1934; No. 151, Armstrong & Heim, 1940; No. 187, Lasareff, 1937; No. 774, Beyne, 1924; No. 1012, Lancaster, 1919.

XX. Color Vision

A. ADAPTATION

239. TALENTI, C.: *Influence of colored lights on retinal adaptation (Influenza delle luci colorate sull'adattamento retinico).* IV. Congr. Internaz. di navigazione aerea, Rome, Oct. 24-30, 1927; 4 :645-57, 1928.

Using only two subjects, due to difficulties in training, the author experimented with colored lights (white, red, green, yellow, blue) of equal optical value to determine the time of return of retinal adaptation. He concluded that, under the experimental conditions, all the colored lights when equal in optical value disturbed the retinal adaptation equally. Concerning intensity of stimulus, there was a difference in action on the foveal and peripheral portions of the retina. In the periphery, more sensitive to light than color, the time required for return of sensitivity to threshold values was doubled when intensity of excitation was doubled. In the fovea, with equality of stimulus, there was a slightly greater loss of adaptation than in the periphery; this was increased very little with doubling of the intensity of excitation.

The author also investigated the protection of dark adaptation by the use of stenopeic spectacles. He found they reduced exactly one-half the loss of adaptation using the same length of time of the light stimulus. The author acknowledged that flying conditions make it impractical for pilots to use such spectacles, but that observers and others may use them with advantage.

B. ALTITUDE

See: altitude—anoxia—color vision.

C. ANOXIA

See: altitude—anoxia—color vision.

D. BLINDNESS (COLOR) AND ANOMALIES OF COLOR PERCEPTION

240. BATESON, W.: *Mendel's principles of heredity.* Cambridge, University Press, 1913, pp. 413.

Complex systems of sex-limited descent are followed by certain abnormal conditions in man. Of these the most familiar is color blindness.

Color-blind persons are commonly male (4 per cent of the European male population as opposed to less than 0.5 per cent of the female).

Children of color-blind fathers usually are not color-blind. Their daughters, however, frequently transmit color blindness to their sons again. Males in such families not affected by color blindness do not transmit this condition, and their posterity is exempt, unless the condition is reintroduced by marriage.

The transmitting daughters of color-blind fathers are heterozygotes in whom the affection is recessive.

The most obvious test of the nature of the inheritance is provided by families of color-blind women.

Color blindness is a condition produced by the addition of a dominant factor.

It is not, therefore, a condition due to the omission of something from the total ingredients of the body, but is plainly the consequence of the addition of some factor absent from the normal.

This added element has the power of paralyzing the color-sense, somewhat as, for instance, nicotine-poisoning may do.

241. WAALER, G. H.: *On the hereditary conditions of various types of congenital red green color blindness (Ueber die Erblichkeitsverhältnisse der verschiedenen Arten von angeborener Rotgrünblindheit).* Acta ophth. 5 :309, 1927; also: Ztschr. f. indukt. abstammungslehre 45 :279-333, 1927.

With the above question in mind the author made a study of 18,121 school children in Oslo—9,049 boys and 9,072 girls. In addition to these children, he examined a large number of normal and color-blind relatives of the color-blind children.

Examination of a number of color-blind brothers and more remote color-blind relatives showed that, in the vast majority of cases, the same type of color blindness is found in these related individuals. The author found four types of color-blind individuals: protanopic, deuteranopic, protanomalous, and deuteranomalous. The fact that the same type of color blindness was usually found in related individuals proves that each of these types may be ascribed to its particular hereditary factor in the X chromosome. The assumption that these four types are phenotypical variants, or are induced by modifying factors in the other chromosomes, does not agree with the author's line of reasoning.

242. CAANITZ, H.: *On total color-blindness (Zur totalen Farbenblindheit).* Deutsche Mil.-äerztl. 2 :125-28, 1937.

The author says total color blindness is extremely rare, with the number reported in the world literature less than two hundred. When the color vision is totally absent, the patient

suffers from other visual disturbances which are likely to become evident early in life. Here we have a report of 3 cases of color blindness in brothers, all with poor vision and all more comfortable after dark. None of them could obtain relief or correction of poor vision with glasses. Another brother had impairment of vision but got relief with glasses. All of the men were physically strong and well in other respects. No mention of progeny is made. There was one brother said to have normal vision and two sisters, not yet examined, who likewise were said to have normal vision. No mention of marriages or progeny is made in these three either. The parents of these seven siblings were no longer living, but were said to have had normal eyes. They were not blood relatives. The father was a mason and farmer and died at the age of 51 from a renal affection. No information on the cause of the mother's death is given.

243. COLLINS, M.: *Colour blindness*, New York, Harcourt, Brace & Co., 1925.

The following subjects are discussed in this book: brief historical survey; color theories, with special reference to color blindness; description of tests and discussion of results; and brief diagnosis of individual cases.

There is also a bibliography at the end of the book.

244. COOLEY, E. E. AND GROW, M. C.: *Color vision*, Department of Ophthalmology, School of Aviation Medicine, Randolph Field, Texas, revised, 1939, pp. 31.

The failure to detect and properly report color blindness on the examination of applicants for commission and for entrance to West Point has caused considerable embarrassment. During the past two years, 2,355 candidates have been examined for admission to West Point. Of this number, 20 (0.84 per cent) were reported color-blind.

The physical basis of color vision is described, as well as trichromic color perception, dichromic color vision, the effect of a shortened red, military significance of color blindness, and tests of color vision.

The author states that the elimination of individuals with moderate degrees of color blindness from flying training should be accomplished. He listed the classes to be eliminated and then stated "this leaves us only with the six-color or hexachromic individuals, the so-called normal, who should be accepted for training in military aviation."

Of the tests for color vision the following are discussed: the Jennings self-recording test, the pseudo-isochromatic plate tests, and the wool yarn test. It is believed that: the Jennings test should be reserved for the preliminary survey of large groups, the pseudo-isochromatic plates should be used whenever it is practicable to do so, final decision in doubtful cases or in cases in which there is some indication of abnormality should be made on the result obtained with the plates, a set containing a large number of wool skeins should be available for the further investigation of some special defect or to confirm the results obtained with the plates. With this procedure very few cases of defective color perception will escape detection.

245. EDRIDGE-GREEN, F. W.: *Colour blindness and colour perception.* London, Kagaw Paul, Trench, Trübner & Co., Ltd., 1909.

This is an early book on color vision. The visual impulse, conveyed along the optic nerve to the brain, stimulates the visual center, causing a sensation of light; and then passing on to the color-perceiving center, causes a sensation of color.

At most, seven distinct colors are seen, while others see, in proportion to their color-perceiving centers, from six to only one. Color blindness results when a person sees only two or three colors instead of the normal six, puts colors together as alike which are seen to be different by the normally sighted. In the degree of color blindness just preceding total, only the colors at the extremes of the spectrum are recognized as different, the remainder of the spectrum appear gray.

246. EDRIDGE-GREEN, F. W.: *The physiology of vision, with special reference to color blindness.* London, G. Bell and Sons, Ltd., 1920.

This book includes a simple comprehensive account of form and color vision. The book is largely concerned with the author's own work, extending over a period of 30 years.

247. FEDOROV, N. T. AND FEDOROVA, W. E.: *A course in general color perception,* Bull. Acad. d. Sc. math. et nat., Sc. nat. 10 :1931-50, 1935. Abstract: Biol. Abstracts, 11 :1458, 1937.

By the action of extreme red and green ≅—511 mμ spectral stimuli on the eye, the authors obtained protanopia or deuteranopia for a short time. They established this by means of a Nagel anomaloscope and the color mixing apparatus of Helmholtz. When the eye is fatigued by some spectral stimuli, all ordinates of each fundamental-response-curve (f.r.c.) are changed in the same ratio as follows from the existence of the "persistence of color equation." Combining the mixture curves for the spectral stimuli 680 mμ 517 mμ 580 mμ for the normal eye with the spectral luminosity curves for an artificial temporary protanopia and deuteranopia, they obtained the f.r.c. for two normal trichromates. The f.r.c. obtained by the authors was applied to the explanation of some phenomena of color vision. *P. W. Salit.*

248. HAYES, S. P.: *Color defects: measurement, classification, heredity.* Psychol. Bull. 23 :547-73, 1926.

In certain cases acquired color blindness is due to a pathologic activity of fatigue poisons upon the pupillary macular nerve bundle. Wölfflin found that, by the use of caffeine and strychnine, the threshold for red may be lowered for deuteranomalous trichromates, while sensitivity to green, yellow, and blue remains unchanged.

Certain authors believe that color blindness is reflected in the face. Taylor affirms that color defect is indicated by changes in the face, voice, and general behavior. This knowledge may be an aid in detecting cases.

Hess considered the "differential—pupilloscope" extremely important for measurements in the diagnosis of acquired or congenital color defects.

Heredity is reported in many cases.

Bibliography of 122 references.

249. HECHT, S. AND SHLAER, S.: *The color vision of dichromats*, J. Gen. Physiol. 20 :57-82, 83-93, 1936.

Protanopes and deuteranopes show one maximum of wave-length discrimination which occurs near their neutral point in the region of 500 mμ (blue-green for normals).

The brightness distribution in the spectrum for dichromats falls only partly outside the range established for color-normals. The protanope curve is narrower than normal, and its maximum lies nearly 15 mμ to the left of it. The deuteranope curves are about the same width as the normal, and their maxima lie slightly but definitely to the right of it. The main difference between the two spectrum sensitivities lies on the red side of brightness curves where the deuteranope is strikingly higher. This difference furnishes the only reliable diagnostic sign, which may be applied to an individual dichromat, for separating the two types.

The average position for the neutral point of 21 protanopes is 496.5 mμ; of 25 deuteranopes, 504.3 mμ. The range of variation in the position of neutral point is twice as great for the deuteranope than for the protanope.

Dichromatic gauging of the spectrum cannot yield unique mixture values for any wave length because of the large stretches of poor wave-length discrimination. Data, therefore, have been secured which locate the spectral ranges that can match specific mixtures of two primaries when brightness differences are eliminated.

The data of spectrum-gauging with two primaries (color mixture) by the dichromat are shown to contain the saturation distribution in the spectrum of the dichromat. This is because each mixture of primaries may be considered as composed of a mixture which matches white and an excess of one primary.

The data, when so computed, yield saturation distributions almost identical to those found by direct measurement and show that, on each side of the neutral point, the basis of color mixture for the color-blind lies in saturation and not in hue differences.

The form of the data is much the same for both protanope and deuteranope, the only difference being relative brightness of the primaries.

Previously accepted anomalies in the spectral matching of dichromats, which have led to the rejection of the third law of color mixture for them, have been eliminated.

They were due to nonuniqueness of color matches and the usually disparate brightnesses of the primaries. Color mixture matches for dichromats are valid at all brightnesses.

The bibliography contains 42 references.

250. JENNINGS, J. E.: *Color-vision and color-blindness. A practical manual for railroad surgeons*. Philadelphia, F. A. Davis, 1896, 115 pp.

The author endeavored to produce a practical work on color blindness. The chapters

include: historical sketch; physiologic anatomy of the retina; physics of light, color sensations; theories of color perception and color blindness; color blindness; method for detecting color blindness; selection tests; pseudo-isochromatic tests; contrast tests; special tests; acquired color blindness; Pennsylvania Railroad Company's instructions for examination of employees as to vision, color blindness, and hearing; and a description of Oliver's series of tests for the detection and determination of subnormal color perception (color blindness) designed for use in railway service.

251. KATZIN, D. AND MURRAY, E.: *Instability in color-naming in normal and anomalous observers.* Am. J. Psychol. 46 :611-20, 1934.

Instability in color-naming is not confined to the anomalous-visioned. No immediate sensory analysis and weighting of the component "r, g, y and b" valences of color quality are possible, even for the normal-visioned. Use of qualifying terms, or of categories, implies previous experiences with a graduated color continuum, plus the ability to carry this in mind and to achieve imaginary scaling on it of the quality present. Any actual color experience is adequate to provoke a shift in judgment in one direction, or the other, independent of sensory adaptation or induction.

In the color-deficient, such allocation of hues is achieved by reference to quantitative rather than qualitative continua (chroma or brilliance), the graduations of which, however, individuating qualitative terms are attached.

252. KRAVKOV, S. V.: *Color vision and auditory stimuli (La vision chromatique et les excitations auditives).* 15th Internat. Congr. Ophth., Cairo (1937), 4 : comm. libres, 7-10, 1938.

Experiments were conducted on four subjects having normal vision. After 40 minutes' dark adaptation, an auditory stimulus (frequency near 2,100, nearly 800 vibrations per second, rather high intensity) was introduced for 10 minutes. The level at which chromatic sensitivity was maintained during auditory stimulation was compared with that preceding the auditory stimulus. It was found that, for the blue-green portion of the spectrum, values were greater than 1, while for red portions of the spectrum, values were less than 1.

In conformity with these observations, they found in experiments with 16 subjects that Rayleigh's equation, established with the Nagel anomaloscope, undergoes an alteration toward protanomalia under the action of an auditory stimulus.

Experiments were made on a protanope and two extreme deuteranomalous subjects, who showed that their sensitivity to color vision for rays of greater than 520 mμ underwent no change. Sensitivity of color vision of dichromatic subjects to the blue portion of the spectrum increased under the action of a sound. These results confirm the supposition that "auditory stimulus increases sensitivity of the apparatuses in our chromatic vision which perceive blue and green and diminish sensitivity of the apparatus perceiving red." It also proved that the curve of the apparatus perceiving red coincides with that of the apparatus perceiving green.

The fact of the existence of two reactions opposed to each other which are undergone by the green-blue apparatus and the red apparatus of our eye, with respect to the action of an auditory stimulus, gives rise to the supposition of the existence of an antagonism between the physiologic processes determining functioning of the red apparatus on the one hand and the blue-green apparatus on the other.

This gives rise to the problem whether, in setting standards of intensity for luminous signals of different colors, one must take into account auditory exciters. The author will study different tonalities and intensities of auditory exciters upon visual function.

253. MUNSELL, A. H.: *A color notation.* Baltimore, Munsell Color Company, 1926, Ed. 7, pp. 105.

The table of contents includes: color names; color qualities; color mixture; prismatic colors; the pigment color sphere; color notation; color harmony; a color system and course of study based on the color solid and its charts; and a glossary of color terms.

254. MUNSELL, A. H.: *A color notation.* Baltimore, Munsell Color Company, Inc., Ed. 8, 1936, pp. 72.

The table of contents includes: Part I—color notation; color score, color arrangements; physiology, psychology, physics, color education, the chromatic tuning fork, color atlas; Part II—perspective diagram; evaluation; application; traditional color names; and a dictionary of color terms.

255. MURRAY, E.: *Color problems: the divergent outlook of physicist and psychologist.* Am. J. Psychol. 42 :117-27, 1930.

Recourse to the retina in the interests of certain psychophysiologic enigmas, e.g., the neutral correlates of quantitative and intensive differences, has motivated other studies; while innumerable problems soluble only in psychologic terms have been turned up of late by illuminating engineers. Discrepancies in the results of these and earlier researches are due not merely to divergent outlook and methods but also to idiosyncrasies in the visual systems of various observers.

One stumbling block in the way of the psychologic reader, obscuring evidence and precluding comparison of data, is the physiologist's sheer inability to distinguish saturation from brightness differences on theoretical grounds.

The belief that the partially color-blind distinguish red and greens primarily by brightness, instead of by saturation, is misleading.

Experimental methods: The value of the much advocated Rayleigh equation is virtually nil, except to adherents of a rigid three component theory. Instead of working with two invariables, as assumed, it deals with three unknowns.

The Hess method is far more suggestive and less misleading.

The shift of hues with alteration of objective intensities, with simultaneous induction, or mal-accommodation, should always enter into the experimenters' calculations.

256. PARSONS, J. H.: *An introduction to the study of colour vision.* Cambridge, University Press, 1915.

The book includes: (1) The chief facts of normal color vision; the bases of color vision; the spectrum as seen by the light-adapted (photopic) eye; the spectrum as seen by the dark-adapted (scotopic) eye; regional effects; areal effects; and the evolution of color vision. (2) The chief facts of color blindness: color names; dichromatic vision; anomalous trichromatic vision; and monochromatic vision. (3) The chief theories of color vision: general review; historical review of modern theories of color vision; the duplicity theory; the three component theory (Young-Helmoltz) (statement of the theory—normal color vision; dichromatic vision; anomalous trichromatic vision; approximate dichromatism; anomalous trichromatic vision; shift of a sensation curve); the opponent colors theory (Hering) (a statement of the theory; researches based upon the theory); and other theories—Donders' theory, Ladd-Franklin theory, McDougall's theory, Schenck's theory, Wundt's photochemical theory, G. E. Müller's theory, and Edridge-Green's theory.

257. PARSONS, J. H.: *An introduction to the theory of colour vision.* Cambridge, University Press, 1927, pp. 254.

The table of contents includes: the genesis of perception; receptors; instinct; perceptual patterns; cutaneous sensations; the evidence from comparative anatomy; the dyscritic motor response; the perception of space; the perception of movement; the dual mechanism of vision; epicritic vision; induction; visual excitation and conduction; comparative anatomy of the eye; and man and his ancestors.

258. PIPER, H.: *Observations in a case of total color blindness of center of retina in one eye and of violet blindness in the other (Beobachtungen an einem Fall von totaler Farbenblindheit der Netzhautgentrums im einen und von Violettblindheit der anderen Auges).* Ztschr. f. Psychol. 38 :155-88, 1905.

This is a study of a case of an official, 49 years old, who had always found it difficult to distinguish colors. He had never had ophthalmologic treatment until 12 years ago when he developed asthenopic disturbances and consulted an eye specialist in order to have glasses prescribed. In this connection the peculiarities of the man's color vision were discovered. The glasses did not improve the condition. There were no signs of old syphilitic affection.

Detailed examination and study of the case revealed the following: The center of the left retina was totally color-blind. The light values of the homogeneous lights in the spectrum were (for the eye adapted to light) identical with the values found in normal eyes properly adapted to light, i.e., the light maximum lay in yellow-orange. Since the retina, when adapted to dark, showed completely normal capacity for stimulation (maximum of light in green), we have in this eye two different totally color-blind apparatus existing side by side, each with its own typical conditions of excitability. In the right

eye the central and the paracentral portions of the retina were violet-blind. At the same time there was a certain weakness of the red-green sense.

259. PITT, F. H. G.: *Characteristics of dichromatic vision with an appendix on anomalous trichromatic vision*, Gr. Brit. Medical Research Council, Report of the Committee on the Physiology of Vision: XIV, Special Report Series, No. 200, 1935, pp. 58.

Trichromats, dichromats (protanopes, deuteranopes, tritanopes), and monochromats are discussed.

The Wright colorimeter is described in which light from a pointolite lamp is focused on a slit and made parallel by a collimating lens. A parallel beam, after passing over a right-angled prism, passes through dispersing prisms. The top half of the dispersed beam passes over the top of the right-angled prisms, through the lens, and is brought to a focus in the form of a spectrum. The lower half of the dispersed beam is turned through 90 degrees by a right-angled prism, passes through a lens, and is also brought to a focus in the form of a spectrum at another point. The portions of the latter spectrum are used as primaries; these portions are reflected back by three right-angled prisms through the optical system to another right-angled prism where they are reflected on to the photometer prism.

Measurements of dichromatic coefficient curves, as well as of luminosity curves and hue discrimination curves, saturation or colorimetric purity, and qualitative tests are described.

The Board of Trade lantern test, the Ishihara test, and the Nagel anomaloscope are discussed.

A subdivision is devoted to the connection between dichromatic and trichromatic colors. Appendix I is on "Some Anomalous Trichromatic Measurements." Appendix II is entitled "Some Further Theoretical Considerations" and is by W. D. Wright.

260. SAMOILOV, A.: *Clinical studies in color blindness*, Sovet, vestnik. oftal, 4 :22, 1934.

261. SAMOILOV, A.: *Clinical investigation of color vision. Color perception in achromates*, Vestnik. oftal. 7 :200, 1935.

A 15 year old girl suffering from marked photophobia and impairment of vision was found to be color-blind. She also showed clearly that the maximal brightness of the spectrum was in the region of green, while the standard yellow color was even darker than the blue color. The objective control of perception of separate color tones was verified by measuring the width of the pupils by illuminating the eye with various colored light filters. There was a marked difference in the width of the pupils in perceiving colors by normal trichromates and monochromates. *Olga Sitchevska, M.D.*

262. SELBECK, A.: *Concerning the lack of color vision found in many individuals (Ueber den bei manchen Personen vorkommenden Mangel an Farbensinn)*, Arch. d. Physik. u. chem. 42 :177-233, 1837.

The author reported on 12 color-blind individuals whom he examined, added one case studied by his father, and completed his series with several who were observed less completely. He found that this condition is much more frequent than is usually supposed. In the 40-odd young people in the two upper classes of a gymnasium, he found five who were shown in his examinations to lack color sense. In some instances this defect in the visual sense was unnoticed by the patient and his near relatives. He found that it was much more frequent in blue-eyed than in dark-eyed persons but adds that this might be due to the predominance of blue eyes in his country (Germany). He found that it was also more frequent in male than in female subjects. This, he thought, might be attributed to habit and training of girls (choice of wearing apparel, work requiring choice of colors, etc.) which would result in a certain amount of development of any color vision that might be present. He quotes extensively from the literature on color vision, including Goethe.

263. THORNE, F. H.: *Color vision, its evolution and congenital anomalies encountered.* Proc. Post Graduate Course in Aviation Ophthalmology and Aviation Medicine, George Washington University, School of Medicine, Vol. 1, 1940, pp. 70-76

Accurate and rapid discrimination of colors becomes important to the flier when selecting emergency fields, recognizing colored signals, and in reading colored maps. In selecting landing fields, the character of the terrain may be determined to an important degree by its color.

A brief outline of the theory of the evolution of color vision and the types of defectives encountered is given.

The Ishihara is probably the most sensitive and the most rapid method available in the detection of significant color blindness, namely, red-green with and without a neutral band and the short red band. There is a table listing the Ishihara plates as read by the normal, the incomplete, and the complete red-green color defectives.

264. TURNER, W. D.: *Defects of color vision: their vocational incidence and pratical control, acquired defects.* Psychol, Bull. 33 :448-64, 1936.

Color defects of various kinds accompanying cerebral injuries are reported. Destounis points out a case of hallucinatory and paranoid tendencies aggravated by vocational consequences of protanopy.

Among railroad officials from 0.76 to 10 per cent were found to have defective color vision by various examiners. In a group of German sailors 2.9 per cent showed defects in color vision, 3.3 per cent of British seamen, and 1.7 per cent of recruits.

The action of a number of drugs is reported. Reduction of sensitivity for long wave lengths and enhancement of it for short wave lengths was produced by alcohol (at least 30 cc.), cocaine, atropine, pilocarpine, and morphine; the effects were reversed with strychnine, caffeine, pichrotoxine, quinine, and santonin.

One case of intermittent chloropsy, following treatment of barbituric poisoning with strychnine, is reported.

Bibliography of 166 references.

265. VELHAGEN, K., JR.: *The problem of color capability in aviation (Zur Frage der Farbentuechtigkeit im Luftverkehr)*, Luftfahrtmed. Abh. 1 :127-34, 1936-1937.

The author described the various forms of color disturbances and points out the importance of good color vision with regard to flying staff. Red, green, white lights, colored fireballs, signal rockets, and colored cockades must be spotted in a very short time. Fog and dust may cover the lights or change the shade; fatigue and strain may increase the difficulties of the color-weak pilot.

The investigations resulted in detection of 50 per cent of mistakes made even under favorable conditions on the ground.

Velhagen recommends thorough investigation with the well known pigment charts and the anomaloscope. Special tests must be used for color asthenopia and malingerers.

The following points are emphasized: (1) Color vision is necessary for pilots. (2) The usually used tests are not too selective. (3) A system of investigation similar to that used on railways is recommended. (4) The anomaloscope test is indispensable. (5) The opthalmologist has to decide about the use of pigment charts, lantern test, and anomaloscope. (6) Dubious and forensic cases need special consideration. (7) There are no remedies to improve color vision. (The results of tests with neophan-glasses were not satisfactory.) (8) Physicians ought to demand the abolishment of color signals. Airplanes ought to be adapted to human requirement. Sufficient supply of oxygen is essential for color vision. (9) Preinvestigations should be improved. (10) Practical examinations without a physician's cooperation are useless (11) Physicians should refuse responsibility, with regard to inadequate examination of color anomalous persons.

266. WILSON, G.: *Researches on colour blindness*. Edinburgh, Sutherland and Knox, 1855, pp. 180.

Total color blindness is very rare. It is remarkable that insensibility to colors is not only compatible with distinct vision in other respects, but appears frequently to be attended by a perception of objects very faintly illuminated, such as those sensible to colors do not possess. A retina unfatigued by impressions of color will preserve by the reception of tints of all kinds, cannot retain.

The second variety of color blindness where the nicer shades of the more composite colors alone are mistaken, is the rule, rather than exception, in the majority of persons, at least of the male sex.

The power of discrimination is often dormant rather than absent.

The third form in which colors are mistaken for different ones, or all confounded together, is the most important variety of this affection. In extreme cases, there is no certainty as to any color.

Red is the primary color most distracting to subjects of color blindness. For some red does not exist, for many it is undistinguishable from green, and some cases are connected with confusion or identification of red with green, or even (very rarely) with black.

False perception of colors may be due to the chromatic condition of certain portions of the optical apparatus of the eye, or to a peculiar organization of its nervous apparatus, including so much of the brain, as is essential to vision.

The chromatic theory, the relation of the general color of the retina to color vision, and the relation of the yellow spot of the retina to color vision are discussed.

267. WILTBERGER, P. B.: *A preliminary report of a study of color perception and its practical application in aviation*, J. Aviation Med. 10 :47, 1939.

Since the early appreciation of the fact that there were certain individuals who did not see colors normally, there has been little or nothing done to enable them to see these colors.

The tests which are in use today sometimes brand an individual as color-blind when, as a matter of fact, he is not color-blind. These tests, while fast and time-saving, should be supplemented by other tests before labeling a person as color-blind.

Blue-yellow defective individuals are "pastel color-blind" or they may be said to be "anomalous trichromates." The defect is not one of color blindness but one of a relatively high threshold for red in the peripheral sense organ (retina). The defect is definitely not central (brain). For, by simply placing the correct color filter before their eyes, thereby lowering their threshold for the red component of the spectrum, these red visual impulses are allowed to reach the color receptor (cones) with sufficient intensity, while othe other color impulses are held back somewhat.

The Ishihara test for color vision is simply a pastel camouflage for certain numbers printed on charts with the background consisting of dots of "confusion" colors. At a distance, it is quite difficult for the trichromate, or normal individual, to recognize these numbers if he has never seen the chart before. Hold a light cherry-red filter before the eyes of a normal individual and notice how vividly the numbers stand out from the background. In this manner an army or navy observer can easily identify "camouflaged" objects, which are painted with ordinary zigzag bright colors, by merely placing over the eyepiece of his telescope a delicate cherry-red-color filter.

When an attempt to make an object, such as, an ocean ship, a battleship, or an airplant or gun emplacement, more or less indistinguishable to the normal individual, it would be well to use those colors applied in such a way that the use of filters will not make them stand out in bold relief from their surroundings.

Properly to render an object invisible or greatly decrease its visibility, it should be painted a delicate gray, shaded with a light blue or light green. And even then, it should be studied through a light red filter until the proper shade is obtained.

The use of filtered spectale lenses or filters incorporated in windshields for that 10 per cent of the population who have high threshold for red, is advised so that they may see traffic lights.

Wiltberger believes the color perception to be in the "end organ for vision," the cones, located within and very near the fovea centralis is the cortex. He believes that Hering's theory of color vision is more nearly the correct one, although it is explained incorrectly.

See also: No. 179, Wilmer, 1918; No. 233, Pilman & Taradina, 1935; No. 235 and 236, Wechsler, 1933; No. 436, Grow, 1921; No. 445, Planta, 1928; No. 449, Schmidt, 1936-37; No. 458, Collins, 1918; No. 718, maintains that Halben, 1914; No. 726, Strughold, 1938; No. 1000, Helmholtz, 1924; No. 1069, Schnelle, 1935; No. 1212, Berger, 1917; No. 1221, Lawrence, 1930.

268. BONNER, W. F.: *Monocular color blindness.* Am. J. Ophth. 9 :603-605, 1926.

Three cases of monocular color blindness are reported. In one, the dominant eye was color-blind but when the eye was covered, the examinee had normal color vision. The report is based on: rarity of occurrence, and the necessity of examining each eye separately for color vision. The cases presented showed (1) partial; (2) total monocular color blindness; (3) binocular color blindness caused by color blindness of the eye of choice, but normal color vision in the other eye, after the poor eye had been occluded.

All occupations requiring normal color vision should have the eye examined separately.

Other pathologic conditions are often associated with color blindness; therefore, color vision tests should be included in the oculist's routine examination.

E. CAMOUFLAGE

See also: No. 267, Wiltberger, 1939.

F. CLASSIFICATION OF COLOR ANOMALIES

269. CAANITZ, H.: *On the nature of inherited disturbance of color vision and its practical significance for marine, railroad and air travel (Vom Wesen der angeborenen Farbensinnstörungen und ihrer praktischen Bedeutung für Marine, Eisenbahn, und Luftfahrt).* Deutsche med. Wchnschr. 61 :306-11, 1935.

According to the author color weakness is not given sufficient consideration in the early examination of candidates for marine, railroad, and air services. Color weakness occurs in 10 per cent of the male population: Green weakness, 6 per cent; green blindness, 2 per cent; red blindness, 2 per cent.

The sense of light and dark to a certain extent aids color-weak individuals in distinguishing colors in everyday life; but the red-green blind are handicapped when confronted by light signals, cardboard signs, etc. The author listed the following handicaps encountered by color-weak persons. (1) It takes him longer to recognize a color. (2) He needs a larger color surface to recognize it. (3) Pale colors are difficult for him to recognize, so that the mist or fog may prevent color recognition. (4) The process of recognizing color tires him, and he is less efficient in this respect when tired. (5) Negative afterimages are stronger in his case. (6) He is subject to simultaneous color contrast. For these reasons a color-weak man should not be employed in transportation services.

Caanitz believes that a strict examination is essential. "Pigment tests" (made with color charts and tables) must be administered in daylight. The charts must be especially clean, never touched by fingers, and exposed to light only during the test. Nagel, Podestà, Stilling, and Ishihara tests are used in Germany; the author recommended the latter.

270. DIMMICK, F. L.: *Color nomenclature and specification.* Psychol. Bull. 35 :473-86, 1938.

The author summarizes the present status of color nomenclature and specification as one in which there is a considerable interest and activity generated by practical problems in art and industry; but it is significant that these problems have not altered materially from the time Ames (1921) stated them. Physical specification of color stimuli that refer finally to spectral wave length is now highly perfected. However, though the current specification, viz., trichromatic coordinates, is based on certain psychologic observations, the technic of dealing with observers remains at a crude level. Physicists in general are not aware that an observer who is dealt with according to the technic of the psychologic laboratory may be as reliable as any of his own instruments, though there is plenty of indication of this fact in the literature. On the other hand, psychologists have begun to show an increasing interest in the physicist's side of color specification. Largely under the influence of Troland, they have adopted the accurate methods of physics for specifying stimulus conditions. There is also some evidence that the importance of the observer and of control of observational conditions is being appreciated.

The article contains a bibliography of 80 references.

271. DUKE-ELDER, W. S.: *Anomalies of the colour sense, in a Textbook of Ophthalmology. London,* Henry Kimpton, 1 :974-89, 1932.

Classification of color blindness includes: (1) trichromatic vision, with the subdivisions of partial protanopia (protanomaly, or "green-sightedness") and partial deuteranopia (deuteranomaly, or "red-sightedness"). The relative qualities of color mixtures differ from normal in the above. Such condition as mentioned in the foregoing affecting blue, is unknown. (2) Dichromatic vision (tritanopia); wherein color vision is a function of two variables. (3) Monochromatic vision, wherein the entire spectrum appears as of a uniform hue, without color differentiation. This is a completely different type of vision from the types under (1) and (2).

Among uncivilized races, color blindness is common; in civilized countries it occurs in between 4 per cent and 8 per cent of males and 0.4 per cent of females. The most frequent form is dichromatism (deuteranopia and protanopia).

Tritanopia is rare; it is associated with depression in the function of the rods.

Unilateral cases of uncomplicated color blindness are extremely rare.

General dichromatism is transmitted as a typical male sex-linked characteristic, recessive in the female, due to a gene in the X chromosome. Total color blindness is clearly a recessive characteristic.

Variations in normal trichromatic vision may be caused by macular or lenticular pigmentation. If a homogeneous yellow is to be matched with red or green, some people require more red (partial protanopia) and others more green (partial deuteranopia) than normal. The latter is common.

Anomalous trichromats rely on differences in luminosity to a greater extent than normal.

In dichromatic vision, there must be a portion of the dichromatic spectrum appearing white (the "neutral point"). A tritanope has a neutral band in the yellow. Since red and green are not confused, the condition is of less practical importance than in protanopia, or deuteranopia. However, the discrimination of hues in the spectrum is deficient in

dichromats, especially in longer wave lengths, reliance being based on variations in luminosity.

In monochromatic vision (achromatopsia) there is evidence of anatomical defects; it is accompanied by marked pathologic changes.

Tests for color blindness are: the spectrum test; the matching test (Eldridge-Green described a bead test); a modification of matching, namely, the "pseudo-isochromatic diagrams," possessing many advantages; and the lantern test. Less important are: the contrast test; the variations in pupillary reactions in different color lights; and quantitative tests, through which the influence of intensity, saturation, visual angle, and time of exposure in color deficients are determined.

Perversions of chromatopsia are erythropsia, (which is more frequent) and cyanopsia.

Retinal metamorphopsia; retinal macropsia; and retinal micropsia are entirely pathologic.

Bibliographies are under three different headings.

272. TERMAN, S. W.: *A new classification of the red-green blind.* Am. J. Psychol. 41 :237-51, 1929.

The color sphere rather than the spectrum should be used as a basis for tests of color blindness, since differences in saturations and brightness are for the color-blind differences in hue.

An individual's color blindness, or rather color vision, may be described in terms of the "four stage" classification of color vision. Each hue is given a rating of 1, 2, 3, or 4. A rating of 1 indicates perfect vision in that hue, 4 means the hue is seen as gray. The rating of 2 signifies that the bright saturated colors of the hue are seen in their true hue, though somewhat less saturated than they appear to the normal eye, while the light, darker, and less saturated colors are seen as the central unit color of the side of the spectrum on which they lie, that is, as yellow and blue. In stage 3 the saturated colors are seen as either yellow or blue and the others as gray. Occasionally a color does not change in hue, but is seen merely as a weaker saturation of the true hue.

The many different types of confusions made by different color-blind individuals are explained by this classification, for only colors which are seen alike will be confused.

On the color ring there are four critical points. Color vision is poorest at the blue-green, grows progressively better as we proceed to yellow, grows worse again to red, better as far as blue, and worse again until blue-green is reached.

273. VON KRIES, J.: *On color systems (Ueber Farbensysteme).* Ztschr. f. Psychol. 13 :241-324, 1897.

The author has made a study of the trichromatic system, which is represented in the light equations of the majority of individuals with normal color vision. Using the light equations of one and the other type of color blindness, he represented two typically different dichromatic systems, which are reduction forms of the trichromatic system. In addition he found the monochromatic character of congenital total color blindness (with no determinable relation to these trichromatic systems) to be identical with what is known by dichromats and trichromats in "twilight vision."

The study is worked out along mathematical lines, with algebraic equations and graphs.

On the basis of this study, the author believed he was justified in concluding that his findings are in accord with the Young-Helmholz theory, thereby emphasizing their correctness.

The other theories expressed to date have been based on the assumption that, in cases of color blindness, a part of the normal visual apparatus was missing, The author suggested that it may be only a matter of modification.

He found fault with the terms red-green and blue-yellow color blindness, stating that they are misleading because the patient in either case is unable to see either of the colors mentioned.

See also: No. 455, Carruccio, 1930.

G. COLOR ASTHENOPIA

See: fatigue—color asthenopia.

H. COLOR TOLERANCE

274. BALINKIN, I. A.: *Industrial color tolerances,* Am. J. Psychol. 52 :428-48, 1939.

The results of visual tests indicate that it is possible to establish a numerical scale for visual perception of magnitude in relation to color differences. A considerable amount of additional data will be required to provide the information for various spectral regions. Persons who are definitely planning to enter this field of investigation are asked to communicate with the author. It may be possible to provide them with the necessary samples of ceramic tiles for estimations of color differences by the ratio method.

Although the degree of agreement between visual estimations of color differences and those computed from physical measurements is not satisfactory, their application to problems of consumers' acceptance and tolerance control proved of practical industrial value. The use of Hunter's reflectometer for these measurements gave fairly reproducible results within ± 0.1 Judd under most careful operational technic. Further improvements are needed, however, to achieve a better reproducibility of this instrument for routine industrial use under plant-operating conditions. The reduction of color measurements to differences in terms of visual perception by the use of Judd's equation is still a very tedious and lengthy process, requiring at least ten minutes for a pair of samples. The possibility of constructing a nomograph for such computations is now being investigated.

All in all, this paper should be considered only as a trial step in the field of color engineering. What the industry is ultimately looking forward to is an instrument into which two surfaces could be placed for a direct numerical measurement of color differences. The indicating scales of this instrument are to be calibrated in terms proportional to visual perception of color differences in each of their three attributes and also as an integrated single number.

275. Boring, E. G.: *The psychophysics of color tolerance,* Am. J. Psychol. 52 :384-94, 1939.

Any particular color tolerance can and must be measured in terms of the physical units of the color stimulus, since the stimulus scale is an ultimate system of reference.

Scientists interested in color ought to think more about a diagram for sense distances.

First, we should have what might be called a spectogram for the lightness of monochromatic lights. It would be a graph ploted against wave length and energy for constant lightness, a family of curves with lightness varying as the parameter.

Second, we should have the corresponding family of curves—that is to say, the corresponding surface—for wave length, energy, and hue.

Third, we should have a family of curves, and thus a surface for the relation of wave length, energy, and saturation. Maximal saturation occurs at middle energies; very light and very dark colors are poorly saturated.

These three sets of facts together represent a surface in five dimensions. It is the complete spectrogram for monochromatic light. Its dimensions are wave length, energy, hue, lightness, and saturation. Since the figure is a surface, any two of the coordinate values determine the other three, once the shape and position of the surface are fixed.

276. Helson, H.: *Color tolerances as affected by changes in composition and intensity of illumination and reflectance of background,* Am. J. Psychol. 52 :406-12, 1939.

Hue, lightness, and saturation of objects depend as much on background reflectance, and composition of illuminant as on spectral reflectance of the object itself. For in viewing any sample we see it against a particular background and in a given illumination with, perhaps, other samples present in the field of vision. The fact that the eye can move freely over the surface of a sample plane means that we are dealing with a dynamic event whenever colors are being named or matched. Adequate specification must predict the color of objects under the dynamic conditions of viewing, even though this is much more difficult than to assume that dynamic factors can be left out of account.

277. Judd, D. B.: *Specification of color tolerances at the National Bureau of Standards,* Am. J. Psychol. 52 :418-28, 1939.

The various parts of a color specification to be administered by working standards have required different methods for color-tolerance specification. Choice of method is also affected by the article whose color is specified and by the instruments used. Three chief methods are discussed: (1) the standard ICI (International Commission on Illumination) coordinate system; (2) material standard and tolerance sample; and (3) the NBS unit of surface-color difference.

The ICI system applies aptly to color specifications not requiring account of the perceptibility of differences; it yields a precise and reproducible specification of color tolerance in fundamental terms. The use of a material standard and tolerance sample requires a sense-distance judgment; within the limitations of precision of that judgment it is perfectly

adapted to insure tolerances of uniform perceptibility. The NBS unit of surface-color difference is intended to combine the precision and reproducibility of a fundamental system with the aptness of the sense-distance judgment by means of a tolerance sample. The formula for color difference defining this unit makes use of sensibility data obtained over a period of years by psychophysical methods, and in effect interpolates between the various series of stimuli for which color-differences sensibility is known. The NBS unit of surface-color difference suffers from two disadvantages: first, the psychophysical data on which it is based are so small a proportion of the total required for reliable evaluation of the complete surface-color solid that attempts to use the unit still reveal ways in which the interpolations yielded by the color-difference formula may be significantly improved; and, secondly, the unit varies with observing conditions so that the color-difference formula defining it is necessarily rather complicated. The NBS unit is already successful enough to justify its use in some standardization work, but our research continues to be directed toward its improvement. It should be emphasized, therefore, that changes in definition of the unit are to be expected. It is believed that a practical unit of surface-color difference will result from our study and that the definition of the unit will be no more complicated than the tentative form discussed in this article.

278. MacAdam, D. L.: *Representation of color tolerance on the chromaticity diagram.* Am. J. Psychol. 52 :412-18, 1939.

Actual practice in the establishment of color tolerances indicates that visual examination of a representative group of samples and agreement between the manufacturers and representative users of the colored material is more satisfactory to all parties concerned than any theoretical deduction of tolerances from abstract experiments. Tolerances established by such agreement can be represented just as clearly on the ICI chromaticity diagram as on any other chromaticity diagram. The ICI chromaticity diagram is recommended for such use because it has been standardized internationally and used extensively for many years, and because its use will encourage no false simplifications of the color-tolerance problem.

I. DRUGS

See: Abstract No. 248, Hayes, 1926.

J. GOGGLES

See: goggles and eye glasses—color vision.

K. MAP READING

See: No. 263, Thorne, 1940; No. 371, Cooper, 1930; No. 442, Hargreaves, 1936.

L. MISCELLANEOUS INFORMATION ON COLORS

279. Anon.: *Summary of Cambridge and Zurich resolutions with comments received thereon, aviation colours,* Compt. rend. Com. internat. éclair, 9.sess. :469, 1935.

Resolution E 1: aviation red. Aviation red is a color having a hue wave length of not less than 610.0 mμ and a saturation of approximately 100 per cent.

German comments: The German committee proposed that aviation colors should be brought into agreement with the colors used in traffic signals, particularly those on railways and sea services.

Polish comments: The Polish National committee considered it a necessity to define closely the methods to be used for the practical purpose of ascertaining the aeronautical colors.

American comments: method of specification. The recommended definitions are ambiguous because the heterogeneous stimulus is not stated, and saturation is not defined. The following definition and those given under E 2 and E 3 are proposed and assume the Reference Observer and Co-ordinate System defined in the resolutions on colorimetry adopted at the Cambridge meeting. Dominant wave length is based on the equal energy heterogeneous stimulus. Purity is excitation purity, that is, the distance on the mixture diagram from the corresponding spectrum point to the equal energy point (see W. Dziobek and M. Pirani, "Normung von Signalgläsern," Proc. Internat. Cong. on illumination, 1928, pp. 818-33.

"Aviation red. Aviation red is any color having a dominant wave length greater than 0.612 μ and purity not less than 0.99."

British comments: Tests on these colors are in progress.

Resolution E 2: aviation orange. Aviation orange is a color having a hue wave length between the limits 594.0 mμ and 598.0 mμ and a saturation of approximately 100 per cent.

Polish comments: as in paragraph E 1.

American comments: Aviation yellow is any color having a dominant wave length greater than 0.580 μ and less than 0.582 μ and purity not less than 0.97.

Resolution E 3: aviation green. Aviation green is a color having a hue wave length lying between the limits 490.0 mμ and 530 mμ and a saturation of at least 42 per cent.

Polish comments: as in paragraph E 1.

American comments: Aviation green is any color having a dominant wave length greater than 0.495 μ and less than 0.540 μ and purity not less than 0.26.

Unpublished experiments in this country indicated that an orange of dominant wave length 0.605 was confused with a red dominant wave length 0.631 on about 15 per cent of the observations. The separation between an orange of dominant wave length 0.598 μ and a red of dominant wave length 0.610 appears inadequate. The limits proposed are thought to be safe, but no limits should be finally adopted until they have been tested experimentally.

280. Dimmick, F. L. and Holt, C. N.: *Gray and the color pyramid.* Am. J. Psychol. 41:284-90, 1929.

At the beginning of this experiment authors found that their näive Os had only incomplete and inadequate categories for the accurate description of colors. Following the errors of practical tradition, they assumed that green is blue-yellow, that gray is black-white, and that orange, purple and violet are separate color categories. In the course of a long series

of judgments of color-likenesses, all Os found that the necessary and sufficient color categories, or unique colors, were red, yellow, green, blue, black, white, and gray. This gave further justification for treating gray as a unique color. The precise limits of this gray need to be determined by some such method as that suggested by Rich.

281. DIMMICK, F. L. AND HUBBARD, M. R.: *The spectral location of psychologically unique yellow, green and blue.* Am. J. Psychol. 52 :242-54, 1939.

A careful survey of the literature on color reveals no adequate experimental determination of the spectral location of the psychologically unique red, yellow, green, and blue. In most cases there has been a failure to distinguish between mixture primaries, in variable hues, and psychologically fundamental colors. In a series of experiments, carefully controlled both with respect to the physical stimulus-conditions and the psychologic conditions of observations, they obtained with 10 Os the spectral value for yellow 582 mμ for green 515 mμ, and for blue 475 mμ. All but one (red) of the seven reference standards which are necessary for the psychologic description of all colors are now adequately specified.

282. DIMMICK, F. L. AND HUBBARD, M. R.: *The spectral components of psychologically unique red.* Am. J. Psychol. 52 :348-53, 1939.

The amount of "unique" blue (476 mμ) that must be added to spectral red (635 mμ) in order to produce a red which is neither yellowish nor bluish was determined. The just-not-yellow and just-not-blue limits of red were obtained with 5 Os, and a representative red was calculated as the mean between these limits, yielding the value 493.6 mμ. The seven points of reference in the four-variable color equation have now been experimentally established.

283. JONES, L. A. AND LOWRY, E. M.: *Retinal sensitivity to saturation differences.* J. Optic Soc. America, 13 :25-34, 1926.

The results of the examination of eight colors are presented graphically. Since the continuous method was used in collecting data, consecutive per cent purity values represent equal sensation intervals.

Differentiation of the scale-reading curves in the figures contained in this article yielded those showing the sensibility of the retina to purity differences; from them the lumen-purity curves were secured by taking reciprocal values. If another method, namely that of the decrease in per cent purity of each step, against per cent purity, to obtain the lumen curve, is applied, the reciprocal of the lumen per cent purity curve represents the sensibility; integration of the sensibility will yield the saturation scale.

An exact determination of the desired difference limen involves a measurement of the difference in purity of two light-illuminating fields which are of the same hue, but which are noticeably different in saturation.

The Nutting calorimeter was used throughout the authors' investigation.

By application of the flicker photometer, Troland has determined the relative satura-

tion of the spectral hues, and his data are shown as a function of wave length in one of the figures in this paper.

284. KLINCKSIECK, P. AND VALETTE: *Color code [Code des couleurs]*. Paris, edited by Paul Klincksieck, 1908.

Klincksieck stated that this code originated in an effort to standardize the colors used in describing mushrooms. Valette was the chemist for the National Gobelins factory. This code is based on the method of Chevreul. It takes the six main colors of the spectrum, red, orange, yellow, green, blue, and violet, arranged as the points of a six-pointed star, adds red-orange, orange-yellow, yellow-green, green-blue, blue-violet, and violet-red between the respctive points. Finally, between every two of these colors there is inserted a series of five colors, reduced and yet sufficiently close from a practical viewpoint.

Valette discussed colors from the physical viewpoint. He stated that it is probable that color exists only in our eyes, due to their function.

285. MIYAKE, R.; DUNLAP, J. W. AND CURLTON, E. E.: *The comparative legibility of black and colored numbers on colored and black backgrounds*. J. Gen. Psychol. 3 :340-43, 1930.

The relatively poor legibility of black letters on red, or for red letters on black, is clearly indicated.

286. NEWHALL, S. M.: *The ratio method in the revieue of the Munsell colors*. Am. J. Psychol, 52 :394-405, 1939.

The ratio method consists in the estimation by direct impression of the ratio of supraliminal sense magnitudes. The one magnitude or interval is taken as standard, and the ratio of the other to it is then estimated.

The spacing problem is to detect and correct errors of allocation in surface color space of the 400 regular Munsell colors. The readjustments are being made for the samples as mounted on white, on gray, and on black (cardboard) grounds.

The application of the ratio method to the spacing problem proves to be a complicated, meticulous, and lengthy process of choosing vectorial equivalents for sensory magnitudes. The principal attributes are evaluated separately under a flexible instruction.

Os are beset by the real and technical difficulties of the first chroma step, attributive abstraction, and separation of standard and sample. They do not use the ratio method in pure form, but resort to the methods of ranking and single stimuli in the effort to achieve results.

Preliminary results on the respacing of saturation tend to confirm the usefulness of the methods and to suggest that many minor adjustments may prove desirable. Present data indicate that adjustments also will be necessary if the colors are to be corrected for gross variations in background reflectances.

287. RAYLEIGH, F. R. S.: *Experiments on colours*. Nature, London, 25 :64-66, 1881; also (previous article) Nature, London, 3 :234, 1871.

In 1871 the author described some combinations of absorbing media capable of transmitting the red and green, while stopping the other rays of the spectrum, whereby he obtained a purely compound yellow, made up of red and green, free from homogeneous yellow light. In devising such combinations, one has to seek an absorbing agent capable of removing the yellow of the spectrum, while allowing the red and green to pass. An alkaline infusion of litmus was used for this purpose or a solution of chloride of chromium placed in a trough with parallel glass sides. The blue rays can be stopped by chromate of potassium. In a second trough bichromate may be used, exercising the most powerful absorption on the upper end of the spectrum. However, it cannot be mixed with litmus, without destroying the desired action of the latter upon yellow.

Films of gelatine or collodion, spread on glass and impregnated with various dyes, can be used instead of the troughs required for fluids. In conjunction with the litmus, a silver-stained orange glass may be employed, in order to isolate the red and green rays.

By spreading aurine upon pale yellow glass, a perfect absorption of the blue-green and higher rays is obtained.

Soluble aniline blue, whose absorption begins in the yellow and orange, is capable of replacing litmus. Bichromate of potash and aniline blue may be mixed in the same solution. There is no difficulty in so adjusting the proportions, as to secure a good compound yellow.

Maxwell's color box is perfect for systematic observations on compound colors. In portable instruments of this class, the width of the eye-slit, placed where the spectrum is formed, should not contract the aperture of the eye. A certain length of spectrum is necessary in order to attain the desired standard in respect of purity of color; therefore, a sufficient linear extension of the spectrum is necessary.

The required length of the spectrum can be obtained by increasing either the angular dispersion of the prisms or the focal length of the lens by which the image is formed.

M. SIGNALS

288. Fombeure, G.: *Change in color sense (L'altération du sens des couleurs).* Aérophile, 39 :152-53, 1931.

The author stressed aeronautical regulations requiring aviators to recognize colored signals while in flight. In addition to those congenitally color blind, others acquire it by disease; the most generally spread and gravest of these is the optic neuritis of smokers and alcohol drinkers. Two or three months of intemperance is enough to develop this neuritis. Since examination of pilots is an annual affair and should not be more frequent, the author recommended that signals should be by form, number, arrangement of lights, etc., rather than by color.

289. Porru, P.: *Notes on daltonism and signaling with colored lights in aeronautics (Nota sul daltonismo e le segnalazioni con luci colorate in aeronautica).* Racc. Pubbl. Sci. Ist. med.-leg. par. l'Aeronaut. 6 :7385, 1937.

Not available at the Army Medical Library, Washington, D. C.

290. RUFF, S. AND SCHMIDT, I.: *Ability of color blind persons to distinguish colored signal lights used in aviation (untersuchungen über die Erkennung der in der Fliegerei verwendeten farbigen Signallichter durch Farbenuntüchtige).* Luftfahrtmed. 5 :53-65, 1940.

In the signal lights used for the safety of aviation a number of colors, chiefly red, green, and white, are used. Practical examination of subjects with inadequate color vision, using signal lights or star signals, yielded high error figures in some cases, showing that employment of color blind personnel, especially pilots, greatly endangers the safety of night flying. The table shows the average figures for the different series of examination:

Type of Color Vision Anomaly	Fixed Signal Lights—Per Cent Error	Blinking Signal Lights—Per Cent Error	Star Signals (normal) Per Cent Error	Star Signals (special) Per Cent Error
Protanomalous	19.4	0	14.4	0
Protanopic	72.3	13.8	77.5	0
Deuteranomalous	14.6	0	48.8	0
Deuteranopic	28.4	0	45.7	0

Investigations were also made to determine whether it would be possible to change the color signals by added characteristics (blinking or changes in form), thus making them distinguishable to the color blind. The experiments showed that this would be possible, but it would necessitate complete change of the entire extensive signal system. Certain changes of this character have been suggested, but the authors are dubious as to whether the necessary technical and financial resources would be made available, since it would mean doing all of this for only about five percent of the flight personnel (and others who might otherwise qualify in the future).

See also: No. 5, Diringshofen, 1939; No. 1221, Lawrence, 1930; No. 1223, Bourdier, 1938.

N. STANDARDS

See: standards.

O. TESTS

See: examination—color vision.

P. TREATMENT

See: therapeutics—color vision.

Q. VISUAL FIELDS

291. RAUH, W.: *The color vision field in experimental night blindness (Das Farbengesichtsfeld bei experimenteller Nachtblindheit).* Arch. f. Ophth. 141 :545, 1940.

Ten normal subjects voluntarily lived on a vitamin A-free diet for six to seven months. At the end of the period the visual field for movement was not changed. Five subjects showed a crossing of the blue limit with the red limit, and all ten subjects showed a crossing of the yellow limit with the green limit, while normal controls were able to recognize colors clearly. Furthermore, definite night blindness existed. After three months of vitamin A feeding, night blindness disappeared and the visual field returned to normal.

The diet consisted of potatoes, fat (beef and pork), margarine, cereals, meat, cottage cheese, etc. By the middle of the fourth month all subjects had gained 5 to 8 Kg. in weight. By the first of the fifth month the weight was stationary, and by the middle of the seventh month all weights had dropped 1 to 3 Kg. below the initial figures. At the same time all subjects complained of beginning ill-being. Hereupon pure vitamin A or B carotene was added to the diet; five men were given 2,500 international units of vitamin A daily and the other five were given 5,000 international units of B carotene per day. At the end of about six months the reduced sensitivity figures were determined according to Nagel's table. Between individuals they varied between 1,300 and 6,500 reduced units, indicating with certainty that night blindness was present in all subjects. Crossing of blue within the red limit was noted in only five of the men and not in every eye. In all ten subjects each eye constantly showed narrowing of the limits for yellow. In all ten subjects the yellow limit lay either within the green limit or crossed with it. The yellow used in the experiment was so readily distinguished from red and green by normal individuals that error was ruled out. This narrowing of yellow was determined in all subjects on various days. The correctness of the findings was corroborated still further by field of vision tests during administration of vitamin A or B carotene. In the course of three months the A-avitaminosis disappeared completely, and the night blindness was no longer determinable by the adaptometer. The end values now varied between 50,000 and 86,000 reduced units. In the majority of subjects the field of vision had become completely normal; in three there was still slight crossing of yellow over the red limit.

About one-fourth of the article is devoted to a review of the literature; among those whose work is reviewed, there is Kries (1896), Jess and Birch-Hirschfeld.

XXI. Colored Lenses

See: goggles and eye glasses.

XXII. Combat, Eye in

292. BIRLEY, J. D.: *Report on the medical aspects of high flying. The medical problems of flying.* Brit. Med. Res. Council, Spec. Rep. Ser. 53 :5-9, 1920.

The use of Flack's bag experiment enables the examiner to isolate those rare cases of men with heart and lungs stethoscopically normal, who are peculiarly sensitive to the effects of even a moderate fall of barometric pressure so that they are practically debarred from flying. Beyond these exceptional cases, marked differences exist in regard to the reaction of the organism to diminished oxygen pressures when flying at 18,000 feet or above.

The symptoms noticeable, while in the air, are: (1) dyspnoea, frequently connected with

periodic "Cheyne-Stokes" breathing at great altitudes; (2) muscular weakness, through which even simple manipulations, such as, bending down and drawing the shutter of a camera, are involved and felt as "hard work"; (3) impairment of judgment and perception (which has been improved in certain squadrons through the routine use of oxygen; the effects of lack of exygen on the brain being infinitely more important than the more obvious effects as, for instance, hyperpnoea); (4) syncope: loss of consciousness usually comes on slowly in the air and persists for a relatively long time, which is almost like gradually falling asleep; and frequently enabling the pilot to land in spite of it, with verbal assistance from the observer; (5) overfilling of the bladder; (6) frontal headache; (7) vomiting; and (8) hemorrhage from the mucous membranes (rare).

After an hour at 15,000 feet, it took pilots twice as long to sight a target, firing time was increased, and accuracy decreased.

Following landing, fatigue is the most universal and important afterresult of high flying, due to the constant stream of stimuli impinging on the eye, ear, higher centers, muscles, etc., to which the organism is comparatively unaccustomed. Besides frontal headache, slight trouble in the cardiovascular and respiratory systems frequently persist for some time, especially the frontal headache.

"Acclimatization" claimed by certain aviators merely indicates that the flier is accustomed to the symptoms induced.

Suitable clothing is most important in aviation, especially at high altitudes.

Fifty hours of high flying within three weeks is productive of greater strain than 100 hours in three months. Therefore, the organism should be given time to recover.

293. Coppez, H.: *Correction of presbyopia in gun sighting*, Clin. opht. 25 :9, 1921.

After discussing the troubles of middle-aged hunters in focusing on game after seeing it, the author described the sighting arrangement presented by Schanz in 1904. At the tip of the barrel, where the sight is usually found, an indented mirror is placed, the indentation the size of the usual backsight, and a T at the place of the backsight. The mirror doubles the distance from eye to sight, making it easier to focus for presbyopes.

Cheval offered another arrangement. He mounted a corrective lens on the breech of the gun. The sight usually is situated 35 to 40 cm. from the hunter's eye and corrective lens, between 18 and 23 cm. The oculist determines the power of the corrective lens, partly from its position on the gun and partly from the degree of presbyopia of the hunter. The lens is fitted with a protective hood to keep off rain and snow, and two types of attachments are shown, adapted to two types of guns (Mauser carbine and express carbine).

294. Litinskiy, G. A.: *Factors involved in sighting capacity of eye in target shooting, effect of using predominating eye only or keeping both eyes open*, Sovet. vestnik oftal, 9 :870-81, 1936.

The author discussed his previous work on the problem, described the method of examination, compared it with the work of others, and gave a table with details of examination of 50 individuals, 45 with normal vision and five with errors of refraction. His conclusions are as follows:

1. Aiming ability of the eye in overwhelming majority of cases is perfect with the predominant eye.

2. This aiming ability of the predominant eye in an overwhelming number of cases is heightened still more in sighting with both eyes uncovered and in daylight.

3. Real elevation of sighting ability of the subordinate eye during uncovering of the predominant eye occurs in hardly 50 per cent of cases.

4. A second positive conclusion, reheightening of sighting ability of predominant eye by uncovering the subordinate eye, is that it may be profitably applied in training for shooting, when a large group is being taught.

5. The flap proposed by the author aids in making practical use of the positive results from the studies reported here.

The "flap" referred to is described as "a sliding shield on a leather band. This shield is round, 7 or 8 cm. in diameter; it is fixed on a level with the slot (holding gun) by means of a belt. It is placed to the left of the muzzle for the left eye, shutting it off during sighting with the right eye, and to the right of the muzzle, that is, in front of the right eye in sighting with the left eye."

295. O'Connor, R.: *The relation of the eyes to rifle shooting.* Ophthalmology 11 :745 1915.

The ocular requirements needed for good marksmanship are: (1) the necessity of focusing the three-point target front and rear sights and (2) the ability to make rapid change of focus from one to another of these points; (3) alignment once being secured (a) the sights furnish the diffusion images, being seen by indirect vision; (b) the bull's-eye, more especially its lower edge, is seen clearly and by direct vision.

The ocular requirements essential for best results are: (1) normal distance vision, (a) allows locating mark accurately and (b) accurate judgment of distance; (2) sufficient accommodative power to permit clear focusing of the rear sight; (3) normal color perception as an aid in locating the object, perceiving details, and estimating distance; (4) binocular vision in order to estimate distances more accurately.

Optical aids to marksmanship are: black sights to prevent blurring by irradiation of light from them; correcting refractive errors must be absolutely accurate and best prescribed after refraction under atropine. It is best to give astigmatic correction and then add spheres while the patient is sighting at a mark, with the rifle, up to the clearest view of the mark. This allows for the fact that, in aiming, one cannot look through the optical center of the lens as ordinarily placed and also for the fact that the refraction is different through the periphery of the lens.

Amber lenses are of value by: diminishing glare, thus preventing tiring due to excessive contraction of the pupil; cutting out actinic rays; (c) lessening irradiation of white portion of target over bull's-eye, thus allowing the latter to stand out, clear, sharp, and apparently larger; not cutting down to any noticeable extent the actual illumination; assisting in bringing out slight contrasts in shades of green which are those chiefly encountered in nature; and, consequently, on dull days everything is actually brightened.

Concerning rear sights, the disadvantage of the present rear sights are: (a) the necessity of aligning three points; (b) necessity of accommodating to see them; (c) short distance between sights, lessening accuracy of aim, etc.

The advantages of peep sight close to eye are: (a) only necessary to align two points, target, and front sights, the mere act of looking through the peep aligning it; (b) no strain on accommodation; (c) corrective effect of small aperture on spheric aberration and circles of diffusion, thus improving vision; (d) allows more rapid aiming due to these advantages (a and b) and because a much greater field of vision is permitted. A 1 mm. aperture 1 inch in front of the eye permits an 11 foot field for 100 yards of range; (e) increase in accuracy of aim due to increased distance between sights; (f) reducing amount of glare; (g) prevention of side views and lights; (h) the possibility of incorporating amber glass or correcting lens with sight, thus insuring accurate and permanent centering.

Visual requirements: (1) for line of army, the signal and engineering corps: (a) 20/20 in each eye; (b) binocular vision; (c) normal color perception; (d) sufficient accommodation to allow a clear focus at 8 inches from the eye—this does away with the need of setting a limit to a degree of hypermetropia for different ages; (e) eyes free from disease and asthenopia; (2) for officers, cadets, hospital corps, ordnance, subsistence and quartermaster's departments need only have normal vision corrected by lenses, provided there is no ocular disease.

296. SCHANZ, F.: *Mirror sight for fire arms.* *Ophthalmology* 10 :1, 1913.

To overcome the inability of presbyopic sportsmen who are unable to focus sharply the back sight of their rifles, Schanz has adapted a plane mirror in place of the foresight, which shows the image of the back sight far enough away to be accurately focused without accommodation. On the upper part of the mirror is a black point which acts as a substitute for the foresight. Instead of the back sight there is fixed a white disk. When taking aim, the sportsman sees the image of the white mark in the sighting mirror. The target is then brought on to the top edge of the mirror. For the method of attaching the apparatus to the rifle the diagrams contained in the original article should be consulted. Experiments made with the apparatus in Germany gave satisfactory results.

297. WHITELEGGE, W. A.: *Eyestrain in the Royal Navy, with reference to dummery and other ratmas.* Brit. M. J. 2 :438-40, 1912.

The more severe effects of eyestrain are due to intense, bright light, causing blurred spots, or "negative afterimage" which, if persistent, is known as a scotoma. This may be followed by anatomic changes in the retina, pigmentation of the macula and night blindness.

Astigmatism may be a cause of eyestrain, especially hypermetropic astigmatism, giving rise to asthenopia. This is increased, if the error is asymmetrical in one eye, or unequal in both eyes. Myopic astigmatism usually produces defecetive vision.

However, men suffering from eyestrain seldom show seriously defective vision, as estimated by Snellen's test types; therefore, subjective symptoms are the indications for a searching examination of the eye.

See also: No. 126, Armstrong, 1938; No. 336, Doyne, 1924.

XXIII. Compression

See: decompression.

XXIV. Conjunctiva

A. INJURIES

See: injuries—conjunctiva.

B. THERAPEUTICS

See: No. 870, Elliot, 1907.

C. TOBACCO

See: tobacco—conjunctiva.

See also: No. 4, Blakemoore, 1940; No. 18, Gauer & Ruff, 1939; No. 87, Gallenga, 1934; No. 88, Gennaro, 1930; No. 315, Ginestous & Cruchet, 1921; No. 1208, Adler, 1913.

XXV. Contact Lenses

298. Bolder, P.: *Power and magnification properties of contact lenses.* Arch. Ophth. 19 :54-67, 1938.

While particular attention is naturally given to the clinical aspects of contact lenses, especially to methods of fitting them, their optical properties are not fully understood.

Correction of an ametropic eye by contact lens is discussed. The ametropic eye is considered corrected when the principal focus of the corrective optical system (of effective power D.) coincides with the far point of the eye.

The investigation of the comparative size of the retinal images formed in axially ametropic eyes corrected by contact lenses is carried out similarly to that made in spectacle lenses.

The power magnification is independent of the shape of the contact-lens system; that is, it is the same for a given D_v (degrees of ametropia), regardless of the particular powers and thicknesses which the glass lens and the fluid lens have in an individual case. The total magnification is obtained by multiplying the power magnification by the shape magnification.

The significance of contact lenses as a corrective means in aniseikonia does not rest so much on the variability of magnification due to changes in thickness, but is evident in those favorable cases in which the power magnification and the basic shape magnification can be used to equalize otherwise existing differences in size.

It is noted, however, that a remarkable variability of magnification is available when spectacle lenses are used in combination with contact lenses. The reason for this is that the power magnification of contact lenses changes much more rapidly with "D_v" (degrees of ametropia) than the power of magnification of single lenses.

299. Eggers, H.: *Aids in the fitting of contact lenses.* Arch. Ophth. 21 :647-49, 1939.

The fitting of contact lenses can be expedited by a saving of time and trouble in the

determination of the visual curve. The usual procedure can be shortened by the elimination of the ophthalmometric determination and by the substitution of an instantaneous formula for the graph and table. Also additional spherical power in a trial frame can be converted rapidly into an equivalent larger or smaller corneal radius in the contact lens.

Two formulas, one for myopic ($y = \frac{x + 30}{4}$) and one for hypermetropic patients ($y = \frac{34 - x}{4}$), were obtained from the data secured by examining 152 patients for contact lenses.

300. OBRIG, T. E.: *Fitting of contact lenses for persons with ametropia, evolution and* modern technic, Arch. Ophth. 17 :1089-1120, 1937.

Zeiss' ground lenses are more satisfactory than the Müller type. Patients with irregular scleras cannot wear spherical contact lenses comfortably.

Raised corneal portions should be avoided.

The eye should be fitted physically, disregarding refraction, and then the refraction should be determined with the contact lens in place on the eye.

Refractive powers from —20 to +18 D. can be ground on the anterior corneal portion.

It is recommended to make a cast of each eye with the aid of negocoll.

Careful attention should be given to the corneal clearance, the fit of the scleral portion, and the physiologic balance between the solution used with the contact lens and the patient's natural secretions.

Use of nitrazine test paper is a quick, accurate method of obtaining the pH of the patient's lacrimal fluid.

In cases of high ametropia, aphakia or kerotoconus, contact lenses can be worn sucessfully on one eye only.

Blown lenses are reported as being comfortable to wear during the entire day.

There is a bibliography of 68 references.

301. OBRIG, T. E.: *Molded contact lenses*, Arch. Ophth. 19 :735-58, 1938.

The principal difficulty in securing comfort with contact lenses is due to pressure at the limbus, horizontally.

Corneal measurements are most accurately measured from a cast of the anterior portion of the eye.

Irregularity of the scleral portion is also a most important difficulty in securing comfort with contact lenses.

Negocoll proved a harmless and helpful substance with which to mold the eye, in combination with molding shell. In one afternoon three molds can be made from an eye with no ill effects.

A molded lens is more satisfactory than a ground one. The molded lens avoids pressure on the limbus and gives a good fit in the scleral portion.

Measurements of the curve of the sclera and the size of the cornea for molded lenses are obtained from the cast.

Instructions for grinding the corneal portion are obtained by a visual manifest—with the best fitting corneal portion of a trial aspherical contact lens, plus the added refraction required.

Sodium borate-boric buffer solution made up to the pH of the patient's lacrimal fluid is most satisfactory to use as the fluid lens.

XXVI. Convergence

See: muscle balance—convergence.

XXVII. Cornea

See: No. 87, Gallenga, 1934; No. 237, Colombo, 1919.

A. INJURIES

See: injuries—cornea.

B. THERAPEUTICS

See: therapeutics—cornea.

XXVIII. Cyclopia

See: monocular vision.

XXIX. Dark Adaptation

See: light sense—dark adaptation.

XXX. Dazzling

See: light sense—dazzling.

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Mitsui, Y., et al.: Antibiotics and Chemotherapy 1:253 (July) 1951.

"Trachoma and inclusion blennorrhea respond well to treatment with terramycin."

Mitsui, Y., and Tanaka, C.: Antibiotics and Chemotherapy 1:146 (May) 1951.

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